METAL INDUSTRY

18 APRIL 1958

Die-Casting in America

EXCLUSIVE of the values of the dies and special tooling involved and also of the value of plating and other finishing supplied, it is estimated by the American Die Casting Institute that the total value of the die-castings produced in 1957 by American jobbing die-casters was $416,500,000; the tooling and finishing represent an additional $250,000,000. Despite a drop in production during the fourth quarter of the year as a result of the general recession in industry, the output of aluminium die-castings totalled 188,250 tons, an increase of 2·5 per cent over the previous record level achieved in 1956. In addition 14,100 tons of aluminium were used by the die-casting industry in the production of zinc alloys. Seventy-eight per cent of the combined total was of secondary origin, accounting for no less than 54 per cent of the total production of the aluminium refining industry. Of the total consumption of slab zinc, die-castings accounted for 38 per cent, the actual figure being 351,500 tons, a reduction of 3·1 per cent from the 1956 consumption; this in spite of the fact that in November and December the drop in sales of automobiles halved the production schedules of many die-casters.

Die-castings in 1957 again accounted for a larger share of the total production of non-ferrous castings, as they did in 1956. Thus, during the year, die-castings in aluminium were no less than 49 per cent of the total production of aluminium castings; in 1956 they accounted for 47·3 per cent of casting production and for 43 per cent in 1955. Zinc die-castings, in 1957, accounted for 99·0 per cent of the total production of castings in that metal, compared with 98·9 per cent in 1956 and 91·0 per cent in 1955. Gains in percentage usage were also recorded for magnesium and copper-base alloy die-castings in 1957.

Although as a result of the zinc industry's demand for higher tariffs, uncertainty as to the future stability of zinc prices to some extent hampered the development of new zinc die-casting applications, the year under review saw greater diversification of applications than ever before, particularly in such markets as business machines, agricultural equipment, photographic, scientific and optical devices, toys, and sporting goods. The automobile industry, however, continues to be the largest single consuming field for die-castings. Thus the automobile industry absorbed 56·9 per cent of the production of zinc die-castings, 42·8 per cent of that of aluminium die-castings, and 37·4 per cent of the output of magnesium die-castings. The amount of die-castings used per car increased for both aluminium and zinc. For the former the average weight in a car was 30·6 lb. in 1957, as compared with 29·1 lb. in 1956 and 20·3 lb. in 1955; comparable figures for zinc die-castings were 72·4 lb. in 1957, as against 71·3 lb. in 1956 and 68·7 lb. in 1955.

It is obvious that production of die-castings in this country can never compare in volume or value with that of America, although in diversity of applications we have the same opportunities as exist in the States. Unfortunately, there are still too many potential customers to whom the manifold advantages of the die-cast product have not yet been brought home. To a large extent the remedy is in the hands of the die-casters themselves. The American industry has been built up by agressive salesmanship, informative publicity and a boundless enthusiasm for the possibilities of the process. Given these three, there is no reason why the British die-casting industry should not continue to increase its share of the markets.

Out of the MELTING POT

Getting It Through

IN rolling strip from metal powder, the rate of output is limited by the thickness and width of the strip and the rolling speed. While the width is primarily limited only by the width of the rolls, limitations on thickness arise from the mechanics of the process: the need to ensure adequate compression of the powder, to prevent it running through the roll gap, and the need to maintain the roll diameter: strip thickness ratio within certain limits. Rolling speed is limited by the time taken by the air to escape from the powder entering and being compressed in the roll gap. To avoid the above limitations, which are, of course, unavoidable when the now conventional two-roll arrangement is used, it has now been suggested that multiple roll arrangements could be introduced. As a patent specification would put it: various multiple roll arrangements will readily occur to those skilled in the art. For example, two or more pairs of rolls could be arranged side by side in a common horizontal plane, each of these pairs rolling powder in the usual way. The strips emerging from these rolls could be brought together and passed simultaneously between another pair of rolls, placed at a lower level, in which rolls, bonding and further compression of the strips would be effected. Those skilled in the art will also perceive that such a set-up, apart from increasing the output in proportion to the number of pairs of the initial compacting rolls, could also be used to produce bimetallic, clad, and other composite metal strips. Other admittedly more complex but undoubtedly promising arrangements comprising trains or clusters of rolls, with metal powder or powders being fed in and compacted at various points into strips which are subsequently bonded together, finally to emerge in the form of a single consolidated product, can be envisaged.

On Their Own

HAVE you heard the story about the American business man whose worries finally led him to consult a psycho-analyst? After he had stretched out and relaxed on the traditional couch and had started to tell his life history, the psycho-analyst interrupted to say that, as he was extremely busy, he had arranged for a tape recorder to be set up in the consulting room, and would the patient mind continuing his life history, which the psycho-analyst would later listen to and consider at his leisure. The same thing happened on the occasion of the business man's second visit to the psycho-analyst. The latter was, however, very much surprised to see his patient come out of the consulting room a few minutes after he had left him. On being asked whether he had already finished, the business man said: "No, not really; but as I am also extremely busy these days, I recorded last night everything I was going to tell you to-day, and I have just left my tape recorder in the consulting room telling it to your tape recorder." There may or may not be in this story a moral of some sort on the merits or otherwise of mechanization. I was somehow reminded of it on reading of the further progress of mechanization in the field of machining. Contrary to what one might have expected, machine tools from which the human element has been eliminated by the provision of a control system acting on information recorded on a tape, are not invariably successful in turning out an accurate, e.g. three-dimensional, machined part. Still following the principle of avoiding the human element, tape-controlled inspection machines have now been developed for the automatic inspection of parts produced on tape-controlled machine tools. The inspection involves the use of a measuring head, the part to be inspected being moved in a predetermined path, so that all the surfaces are successively carried past a stylus point, any incorrect dimensions causing movement of the point, the deflection of which can be indicated or recorded. The tapes for the inspection machines are prepared in the same manner as those used for the control of the machining operations.

Name Splitting

QUITE often, a name given to something or other is bound to fail in its primary function of completely identifying the object or whatever it is to which it is applied, and valiant attempts are made to introduce more and more names for the purpose of coping with an increasing differentiation brought about by continuing research and development in what had hitherto been a monolithic subject. This can now be seen happening in connection with inert gas arc welding of aluminium and aluminium alloys. Minor modifications to the original tungsten and consumable electrode versions, resulting, for example, from the use of tungsten electrodes containing various additions, and of aluminium electrode wire, surface treated in various ways for the purpose, in both cases, of improving arc stability, were not considered to call for separate distinctive names. Such names have now, however, been found necessary to designate processes developed as a result of research into the effect of protective gas compositions in connection, in the first place, with the hydrogen porosity of welds produced by the consumable electrode process. In the first of these new processes—the "Qualiweld" process—in addition to the usual flow of shielding gas (argon or helium), an argon- or helium-chlorine mixture is fed to the arc zone through the contact tube through which the electrode wire is advanced. The chlorine acts in some, as yet unknown, way to eliminate or reduce weld porosity. In the second—the "Econoweld"—process, welding costs are reduced by replacing the argon or helium shielding gas by nitrogen supplemented by a small flow of argon- or helium-chlorine mixture through the contact tube. The end of the electrode has to be submerged in the weld to break through the surface layer of nitride. The process is unsuitable for alloys containing appreciable amounts of magnesium. Finally, in the third—the "Chlorecon"—process, an outer stream of argon, helium, or argon-helium mixture, of considerably reduced volume is used to surround an inner stream of argon- or helium-chlorine mixture supplied through the contact tube. One is left with the impression that the day of the self-adjusting gas flow/composition shielded self-adjusting arc process cannot be far away, though whether the necessary nomenclature will prove equally self-adjusting remains to be seen.

Skimmer

SINTERED IRON BEARINGS — IRON-COPPER MATERIALS — SINTERED COMPONENTS

Porous and Infiltrated Metal

By J. E. ELLIOTT, B.Sc., A.I.M.

(*Continued from* METAL INDUSTRY, 11 *April*, 1958)

IRON is not regarded as a good bearing material, but the attraction of a low cost article, arising from the availability of cheap, good quality iron powder, has dictated the development of porous sintered iron bearings. It is interesting to note that porous iron bearings perform very well when full-fluid lubrication is maintained. However, when lubrication fails, seizure and damage of both bearing and shaft are likely. Such experiences emphasize the importance of a continuous oil film between shaft and bearing for correct bearing performance: only when breakdown of the oil film occurs does the nature of the shaft and bearing material become very important.

The melting point of iron is 1,527°C. and the sintering of straight iron compacts in nickel-chrome furnaces, which have a normal maximum operating temperature of 1,150°C., achieves only limited properties. For instance, a typical porous iron compact with a density of 6 gm/c.c. would have a tensile strength of about 15,000 lb/in².

Various additions enable the properties of iron compacts to be improved when the sintering temperature is so limited. These elements include carbon, copper, phosphorus, and tungsten. Copper is the most widely developed means of improving the properties of iron compacts, and various iron-copper compositions have become standardized under S.A.E., A.S.T.M. and British specifications.

Iron-Copper Material

The alloy diagram of the iron-copper system (Fig. 6) indicates that limited inter-solubility of iron and copper exists and that, above 1,094°C., liquid copper will persist when the solubility of copper in iron has been satisfied. At the highest sintering temperature which can be used in nickel-chrome furnaces, e.g. 1,150°C., the solubility of copper in gamma iron is of the order of 8 per cent.

The mechanical properties of *solid* iron-copper alloys (Table III) show an increase in strength with copper, but the effect is more marked in the air-cooled condition than in the annealed condition. This difference is due to the ease with which it is possible to supersaturate alpha iron after cooling through the transformation temperature at 833°C.

In practice, the rate of cooling which would be required to avoid the heat-treatment effect is so slow that the normal effect of copper upon the mechanical properties is typified by the air-cooled material quoted in Table III.

TABLE III—MECHANICAL PROPERTIES OF SOLID IRON-COPPER ALLOYS

COPPER per cent	ULTIMATE TENSILE lb/in²	ELONGATION per cent
Annealed		
Nil	51,000	30
5	70,000	21
10	71,500	17
Air Cooled		
Nil	—	—
5	115,000	11
10	148,000	Nil

Precipitation hardening iron-copper alloys, containing not more than 2 per cent of copper, have long existed, and have improved corrosion resistance and strength over those of straight iron. Sintered iron-copper materials, however, contain as much as 25 per cent of copper, but it is more common to use copper additions up to about 10 per cent, since the improvement of mechanical properties is not sustained beyond this level.

A further attraction of the addition of copper to iron lies in the creation of a liquid phase if sintering is carried out above 1,094°C. As with copper-tin mixtures, rapid development of alloying and sintering takes place, and it is possible to develop good strengths within a short period of sintering time. A sintered porous 10 per cent copper-iron alloy, having a density of approximately 6 gm/c.c., may develop a tensile strength of 40,000 lb/in² after sintering for 15 min. at 1,150°C.

The general considerations which apply to the manufacture of bronze bearings also dictate that the cold press and sinter procedure is the best way to manufacture iron bearings, and the basic operations are common.

Raw Materials

The principle which is followed in the manufacture of bronze bearings, i.e. that of using a mixture of the relatively soft elemental metal powders, followed by the development of alloying under liquid phase conditions during sintering, is also relevant to the manufacture of iron-copper bearings.

The outstanding powder for the large-scale production of iron-base compacts is Swedish sponge iron material. The powder is of a low cost, it has reasonable purity, and the compacting properties are attractive. In particular, the green strength and the development of sintered strength are of a high order. The sponge structure is seen in the photomicrograph (Fig. 7).

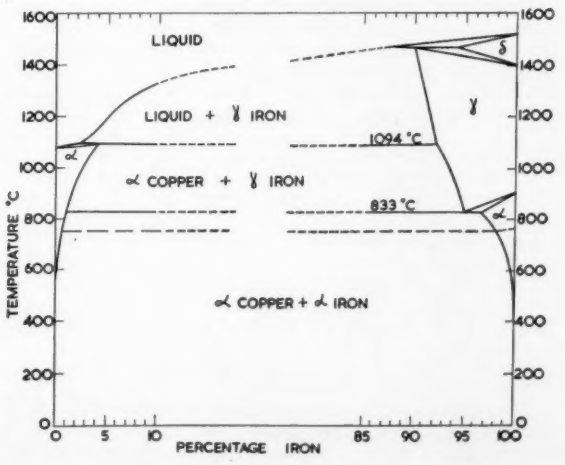


Fig. 6—Constitutional diagram for iron-copper system

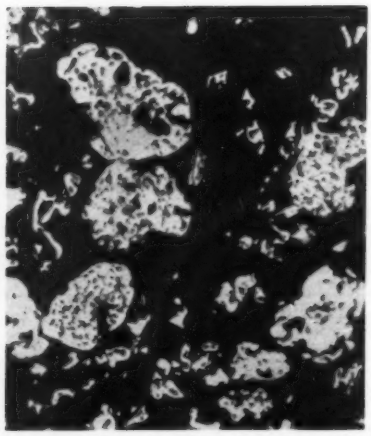


Fig. 7—Swedish sponge iron powder grade MH 100 (×100)

Electrolytic iron powder is also used, but is more costly than sponge powder and the extra cost is only justified where very high density compacts are required; the powder has particularly good compressibility and lends itself to the manufacture of higher density compacts.

The copper powder which is added to iron/copper mixes is required to serve in a similar capacity to the tin powder which is added to copper/tin mixes. Good dispersion of the copper powder in the iron mix is desirable and electrolytic powder is quite commonly used, primarily due to its ready availability in connection with bronze bearing production. Other means of dispersing copper in the iron powder mix have been suggested; in particular, the controlled electrochemical deposition of copper from a copper salt solution.

Graphite may be added to the iron/copper powder mix and facilitates the compacting operations. During sintering, however, graphite alloys with the iron, so producing a steel structure, and it will be appreciated that graphite additions cannot enhance the bearing performance as is thought to be the case with bronze/graphite mixtures.

Compacting operations are very similar to those for copper/tin mixtures, but the harder nature of the iron powder creates extra problems of tool wear. Tool problems are correspondingly more severe and call for a higher class of material as a general rule. Tungsten carbide is outstanding and is generally used more widely for iron/copper than for copper/tin forming operations.

The basic considerations underlying the sintering of iron/copper mixes have already been discussed, and the operations are normally carried out in continuous mesh belt nickel-chrome furnaces. It is possible to use an exothermic type of atmosphere of a reducing and decarburizing nature.

If graphite is added to the powder mix and the carbon is required to be retained, endothermic gas is an alternative sintering atmosphere. It is thereby possible to control the carbon level by adjustment of the amount of the graphite addition and by variation of the atmosphere quality.

Sizing and impregnation operations for iron-copper bearings are similar to those applied to bronze bearing manufacture, but the higher order of mechanical properties of the iron material creates extra problems in the wear of sizing tools.

TABLE IV—CURRENT MATERIALS FOR SINTERED COMPONENTS

Non-ferrous	Copper Bronze (high density bearing material) Brass (90/10, 80/20, and 70/30)
Ferrous	Iron (high density, coined and re-sintered) Iron/copper material (high density bearing material) Infiltrated iron Iron alloys (high temperature sintered)

Sintered Components

As previously mentioned, sintered components come within the category of competitor products, and the interest in powder metallurgy lies in its application as an alternative method for shaping metal components. It competes with the more conventional methods of manufacture, such as casting, forging, extrusion and machining, etc., and the special characteristics, such as porosity, are purely incidental.

The mechanical and physical properties of sintered compacts for component applications are more important than for bearing applications. It has been pointed out that porous metal is always weaker than solid metal, and this is due not only to the lack of metal in the pore space, but also to the stress-raising effect of the inter-particle junctions. It is normal for a compact which has, say, a density of 75 per cent of that of the solid to exhibit mechanical properties which are substantially lower than 75 per cent of those of the solid metal. Accordingly, the yardstick for the successful application of sintered components is more often that the strength is adequate, rather than that it is excessively good.

In addition to the determining factor of material properties, the ability to manufacture the shape by the powder metal technique is outstandingly important. The shapes which can be made are limited, and it is impossible, for instance, to produce undercuts or recessed holes in lateral directions as part of the moulding operation. Extreme changes in section in the direction of pressing should also be limited.

Within the limits imposed by these various considerations, the manufacture of sintered components is a developing field, and is capable of considerable expansion.

A list of the materials which are currently manufactured on a commercial basis in both Europe and North America are given in Table IV. Some of the characteristics of these materials will now be discussed.

High density sintered copper is made on a limited scale for such applications as commutators. Densities in excess of 85 per cent of solid are typical.

Little need be said about high density bronze bearing material, except that higher compacting pressures are used in order to achieve the higher density. Otherwise the manufacturing operations are basically similar to those applied to bearing production, and densities exceeding 7·0 gm/c.c. are normal.

The manufacture of sintered brass reveals a departure from the principles upon which the manufacture of bronze and iron/copper materials is based. The normal approach of using elemental copper and zinc powders encounters special difficulties which are related to the characteristics of the zinc. These difficulties include the high volatility of the metal and the maintenance of fully reducing conditions.

In these circumstances, it is preferable to use pre-alloyed brass powder made by the atomization process. Such powder is made with an irregular particle shape and the compacting properties are good. The normal difficulties that are associated with pre-alloyed powder, i.e. poor compressibility due to the hard nature of the particles, are not pronounced in the case of brass powders since the alloys are, in any case, relatively soft.

The sintering of brass alloys, e.g. 90:10, 80:20 and 70:30, requires considerable care and control. Since there is no liquid phase present during sintering, sintering is relatively slow, and time and temperature are both important. A high quality sintering atmosphere is required in order to prevent the formation of zinc oxide, and an atmosphere of the cracked ammonia type is vital. Volatility of zinc is a problem, even with the alloyed powder, and a partial pressure of zinc vapour is important to prevent undue dezincification.

In order to achieve best properties, sintered brass components are made to a relatively high density, and porosity is generally as low as 10 or 15 per cent. The tensile strength of sintered 80:20 brass is about 20,000 lb/in^2, and elongation is of the order of 10 per cent; the corresponding properties of solid 80:20 brass are 40,000 lb/in^2 tensile strength, 45 per cent elongation.

It has been said that straight iron compacts, which are sintered at a maximum temperature of 1,150°C., have limited properties. The application of a coining operation, after

the sintering treatment, permits the creation of further areas of cold welding in the compact, and these can be consolidated by a further sintering treatment, so enhancing the overall properties of the final compact. Such material is manufactured, as it were, by a double press-double sinter technique. Coining is to be distinguished from sizing in that pressures up to 50 tons/in^2 are used, and a substantial increase in density is achieved.

The density of iron made in this way exceeds the level of 7 gm/c.c., and the properties are much improved over those of the single press-single sintered material. Tensile strengths of 30,000 to 40,000 lb/in^2 and elongations of 5 to 15 per cent are attainable. This class of material comes nearest to that of mild steel and is employed in a number of applications where toughness is required.

Case carburizing is applicable, and a wear resistance approaching that of solid steel is normally achieved.

The double press-double sinter material lends itself to those parts which are of relatively simple shape and which are required in relatively large numbers. The use of nickel-chrome continuous furnaces at temperatures up to 1,150°C., and high speed coining equipment, permits high rates of production of parts of good dimensional precision.

Iron-copper structural material is simply an adaptation of the established bearing alloy to structural applications, although it is normal to manufacture to a higher density.

The production of such material follows the same pattern as that adopted for bearings, but the higher densities are usually obtained by the use of higher compacting pressures. Needless to say, extra tool wear problems are encountered.

Densities in excess of 6 gm/c.c. are usual for structural applications, and tensile strengths of the order of 40,000 lb/in^2 are normal. However, the ductility of this type of alloy is low, and elongations of 1 per cent are typical. From the point of view of mechanical properties, it is reasonable to compare the iron-copper type of material with flake cast iron.

Unlike coined iron material, in which the coining operation substantially reduces porosity and permeability, the porosity is largely intercommunicating, and case carburizing results in carburization of the structure throughout each section. Since toughness is not an outstanding property of the material, full carburizing of the section is no particular detriment and, in any case, surface wear resistance is achieved.

It is interesting to note that the inclusion of copper does not prevent carburizing of the iron structure. The use of copper as a "stopping-off" medium in carburizing might suggest that the carburizing of iron-copper material would be impossible; however, it is probably significant that the copper is alloyed with the iron and is not necessarily free to coat the surfaces of the iron.

(To be concluded)

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

The Presentation of Metallurgical Information

To the Editor of Metal Industry

SIR,—The letter from Mr. J. F. P. H. Greene, in reply to mine on the above subject, suggests that he has not read either Dr. Jenkin's article, my letter or his Fowler very carefully.

Mr. Greene refers to the use of the form "tin, copper-and-nickel" as being an unfortunate abuse of spoken English. Who is his authority? I can find nothing in Fowler to preclude the use of this form. Indeed, if he will refer to page 24, AND 3—which, by the way, is the relevant section, not the one he mentions—he will find the statement, "There is no agreement at present on the punctuation."

Admittedly, Fowler goes on to recommend the use of the extra comma, but even he has to make an exception. (I haven't a copy of the Collins Dictionary, but no doubt the same remarks apply.) Accepted rule? I think not.

In examining the spoken word when considering the written punctuation, I was only following Dr. Jenkin (page 86, column 3) showing thereby that his test was not a reliable one, and certainly could not be used as a basis or justification for the proposed ",and". Similarly, Dr. Jenkin refers to "a quite erroneous rule that seems to be taught in the elementary schools." Erroneous or not, this evidently is "accepted." It follows that, by his own lights, Dr. Jenkin is being unorthodox. Certainly, I still think that in this context the double pause between nouns is unnecessary.

Finally, I contend that good wording is of overriding importance to clear expression. Good wording can stand a certain amount of poor punctuation, but poor wording is only slightly improved by pedantically "correct" punctuation.

Yours, etc.,

I. W. C. Cosens.

8 Eastgrove Road,
Sheffield 10.

Men and Metals

It was announced last week that the Department of Scientific and Industrial Research has appointed **Mr. S. H. Clarke,** C.B.E., M.Sc., as director of the new research station now being built at Stevenage for fuel and process research. Mr. Clarke is the present director of the Fire Research Station at Boreham Wood.

New appointments have been made by Philips Electrical Limited as follows: **Mr. J. D. Callaway,** manager of the company's Cardiff branch; **Mr. D. H. Clark** as television and radio manager of the South-West Region, Bristol, and **Mr. A. D. Shillabeer** as electrical appliances manager, South-West Region.

Following the resignation of **Prof. G. Wesley Austin** as chairman of the Research Board of the British Welding Research Association, **Dr. E. G. West,** Ph.D., B.Sc., has been appointed. Dr. West, who is a Fellow of the Institution of Metallurgists, and Technical Director of the Aluminium Development Association, leaves the country on April 22 next for an extensive tour of Canada and the U.S.A., during which he will visit the principal aluminium producers and fabricators.

In order to take up his recent appointment of stud welding sales engineer for Scotland, N. Ireland and Eire with Crompton Parkinson (Stud Welding) Limited, **Mr. T. G. Gibson** has returned to Glasgow.

Appointed to the board of Crofts Engineers (Holdings) Limited, **Mr. Granville Horsley** has also been appointed as joint managing director of the operating company, Crofts (Engineers) Limited.

Resigning his appointment as executive director of British Straddle Carrier Co. Ltd., of the Fisons Group of Companies, **Col. R. T. Hartmann** is to devote more of his attention to the continually expanding business of Materials Handling Equipment (Great Britain) Ltd., 40a Dover Street, London, W.1, of which he is managing director.

Temperature Indicators

TWO ranges of millivoltmeter instrument, the Pyr-O-Vane and Protect-O-Vane, have recently been introduced by Honeywell-Brown Ltd., 1 Wadsworth Road, Perivale, Greenford, Middlesex. Accuracy on all models is ±0·75 per cent of scale span, with dual compensation for ambient conditions. Control forms available on the Pyr-O-Van controller include on-off, 2- and 3-zone, and time-proportioning action. Neutral zones for 3-position control are adjustable. The Protect-O-Vane model has been specially developed to shut the process down or give an alarm signal when temperature exceeds the set-point.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Polarographic Analysis

SINCE the realization of its ability to effect the complete solution of materials which dissolve only with difficulty by conventional procedures, the use of phosphoric acid in analytical chemistry has assumed greater importance. In conjunction with other mineral acids such as HCl, HNO_3 and HF, the solution of a wide range of materials can be effected, with subsequent removal of the other acids simply by evaporation until only phosphoric acid remains. After such a solution procedure, phosphoric acid is potentially useful as a base electrolyte for the direct determination of constituents in these solutions. Work along these lines has been carried out at the Atomic Energy Research Establishment, according to a report of D.S.I.R., and the polarographic characteristics of several elements have been determined in this base solution. Values have been obtained for half-wave potentials in volts versus the saturated calomel electrode, and for diffusion current constants. Using the square wave polarograph, the phosphoric acid base solution has been applied to the direct determination of copper, lead, cadmium and zinc in metallurgical and other types of sample.

Tube Storage and Handling

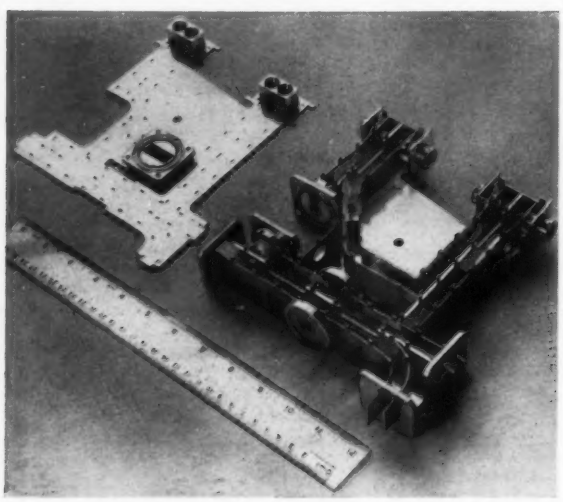
RECENTLY demonstrated at Talbot Stead Tube Co. Ltd., where it has facilitated tube storage and handling, the "Irion" side-operating fork-lift carrier differs from the normal fork-lift truck in several respects. It comprises a four-wheeled platform vehicle, with the power unit and transmission located at the rear, the operating position being to one side.

Situated in a well in the waist of the machine is an orthodox hydraulically-operated "fork-lift" mast assembly, which is capable of being laterally extended from, or retracted into, its normal travelling position on one side of the vehicle, by means of two hydraulically-operated rams. During transportation, control is effected as in a conventional commercial vehicle.

For stacking or unstacking, loading or unloading, the entire mast assembly is laterally extended to the right-hand side of the vehicle. At this stage two hydraulically-operated jacks, one on either side of the well, descend to ground level to stabilize the unit whilst handling the load. The jacks operate independently of one another and each finds it own level according to the configuration of the ground. The forks on the mast assembly can then be lowered to ground level or raised to any height up to 10 ft. 2 in. in exactly the same way as they are raised or lowered on an orthodox fork-lift truck. Lifting and lowering speed averages 36 ft/min.

The side-loading design also obviates the driver's vision being obscured by the load, it permits manoeuvring in narrow aisles, and, additionally, it is suitable for use on roads as well as within factories and yards. It is available in this country through Materials Handling Equipment (Great Britain) Ltd.

A partly assembled dip-brazed aluminium waveguide. This technique developed by G.E.C. Ltd. provides much lighter and more flexible designs



Fabricating Waveguides

A TECHNIQUE for the ready manufacture of almost any shape of waveguide components, providing much lighter and more flexible designs, has been developed by The General Electric Co. Ltd. The process involves the use of specially-coated aluminium sheet, which is punched and assembled by an interlocking tag and slot construction, thus dispensing with the necessity of assembly and brazing jigs. This feature enables the whole unit to be brought up to temperature quickly and uniformly by means of salt-bath brazing, eliminating the distortion experienced with torch brazing methods. In addition, the salt dip-braze produces cleaner and more uniform joints, and on X-band waveguides, tolerances can be maintained to within 0·002 in.

Using this technique, it has been possible to replace a complex system of aluminium die-cast waveguide components for an airborne radar transmitter-receiver. The nett reduction in weight was from 8 lb. to less than 1 lb.

Fume Control

EFFECTIVE means of dealing with the evolution of steam, spray and fumes from chemical processing baths have not been generally available, and the introduction, by Imperial Chemical Industries Ltd., of the "Serseal" layer process marks a further step in fume control. Various grades of "Serseal" have been formulated to suit the different operating temperatures and characteristics of phosphating solutions, acid pickling solutions, and alkaline paint stripping baths.

No structural modification to the plant is necessary, although a simple trap fitted to the rinse tank overflow will recover any "Serseal" material dragged out on the processed work. All that is required to bring the process into operation is to apply a measured quantity of "Serseal" activator to modify the processing solution. Next, the "Serseal" is poured to float on the surface, forming an inert liquid layer. So great is the heat conservation effect that the output of the heating unit must be reduced by at least 75 per cent before "Serseal" is applied, as otherwise the liquid will boil over.

The formulation ensures that there is no interference with the processes being used, and that work can be rinsed easily after treatment.

On a production plant at Folland Aircraft Ltd., Hamble, steam from two "Granodine 101" plants created a nuisance, and condensation attacked steel and aluminium aircraft components. The installation of an elaborate exhausting system was considered. A test of "Serseal" on the smaller of the two tanks was satisfactory and it was, therefore, decided to treat the larger tank, which had a surface area of 48 ft^2 and which gave off most of the steam. The results were striking. Steam is no longer a problem, working conditions are vastly improved, and there is no condensa-

tion. While no accurate estimate of the saving in gas consumption is possible because of the presence of other gas-fired equipment, the saving is estimated at about 75 per cent, and smaller burners have had to be installed. The time taken to heat this tank from cold to 210° F. is reduced from 10 hr. to 2½ hr. The project for an exhaust system has been abandoned.

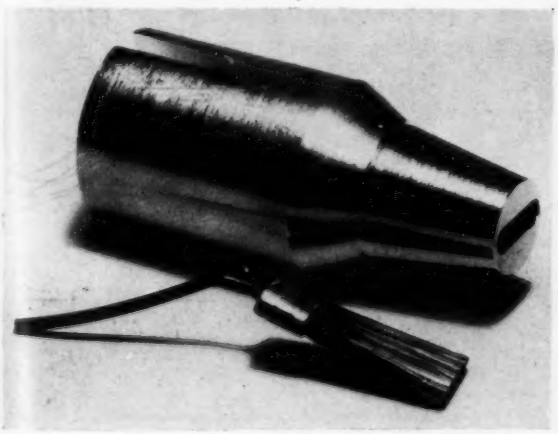
High Frequency Resistance Welding

APPLICABLE to aluminium as well as other metals, a resistance welding process which uses high-frequency power has been developed by New Rochelle Tool Corporation, in the United States, according to *Iron Age*. The process, known as the Thermatool welding process, utilizes two sliding contacts, one on each side of the seam, which convey H.F. current to the abutting edges. Pressure rolls then force the edges together to complete a forge weld. Tubing passes through the mill in the open-seam condition until it reaches the pressure rolls, where the edges form a triangle upon approaching the pressure rolls. The current contacts are just ahead of the rolls. H.F. current passes through two paths as though they were connected in parallel. Current from one contact flows around the back of the tube to the other contact, which is the route of high inductance, while current from the second contact takes a V-shaped path along the tube edges to the first contact, this being the path of lower inductance. A current frequency of 450,000 cycles/sec. is used. Direct heating is, therefore, confined to the abutting surface areas, which causes the metal on these edges to reach welding temperature before the rolls apply pressure. The edge heating effect of the H.F. current permits the use of lower current than with 60 cycle to achieve the same results. The capacitative action of the H.F. current eliminates the necessity of cleaning to remove the oxide film on the abutting edges of the seam. Aluminium tubing of 1 in. outside diameter, 0·049 in. wall thickness, can be welded at 225 ft/min., and 6 in. outside diameter aluminium tubing of 0·062 in. wall thickness can be welded at 113 ft/min. The process is applicable to strip materials, tapered tubes, and in welding tapered tubes and strip to tube, and similar applications. The metals which can be welded with the same equipment, with no adjustment except heat control, include: copper, galvanized steel, mild rolled steel, etc., as well as aluminium alloys.

Soldering Aluminium

RECENT improvements to the Belark aluminium soldering tool have simplified some of the problems associated with the tinning and soldering of aluminium. This tool, manufactured by the Belark Tool and Stamping Company Ltd., works by means of a vibrating wire brush located in the centre of the solder bit. An additional broad bit has recently been introduced which allows the use of a large brush. The result of this is that at every stroke up and down the workpiece this new brush covers a much larger surface than could be achieved with the original small brushes, and the all-important time factor for the whole operation is greatly reduced. This equipment is easily interchangeable with the existing bits and brushes, and can be supplied immediately to everyone already using the tool.

The broad bit and brush introduced by Belark Tool and Stamping Co. Ltd., to facilitate the soldering of aluminium



Radiation Counting

DESIGNED and produced as a low-cost general purpose detector of gamma, hard beta and X-radiation, a utility Geiger counter made by Radiation Monitors Limited, of 52 Tottenham Court Road, London, W.1, is manufactured under licence from the United Kingdom Atomic Energy Authority, and employs a patented circuit evolved at the British Atomic Weapons Research Establishment.

A self-contained, light weight portable instrument employing the latest type of highly sensitive low-voltage halogen-quenched tube, the counter provides three ranges of visual response by flashing neon, together with a loudspeaker count of each single ionizing event at low radiation levels, and thus gives an immediate appreciation of any significant flux change.

Thumb-operated controls permit single-handed operation on the medium and low ranges, but an extra long shoulder strap is provided for convenience when field surveying or prospecting for thorium or uranium ores.

A pulse output socket provides for muting the internal speaker and substituting a miniature crystal earpiece, or for attachment to an oscilloscope or recording scaler. The size is 9 in. by 6 in. by 3 in., and the weight 3 lb.

Welding Copper Vessels

IN the fabrication of a large cylindrical copper vessel, destined for use on a liquid weighing machine, the Hull firm of W. Broady and Sons have employed a double operator vertical method of welding.

The vessel was constructed of $\frac{3}{16}$ in. thick copper, and Saffire oxy-acetylene hand welding blowpipes, supplied by British Oxygen Gases Limited, were used to carry out the work.

The double operator vertical method of applying butt welds can be employed where seams can be placed in a vertical position, and where there is access to both sides of the metal.

Advantage can be taken of the higher welding speeds and the greater economy of gas and rod which are obtainable with this technique, which achieves sound penetration with build-up on both sides. Thicker metal can be welded without specially prepared edges.

Welding a copper vessel by the double operator vertical method at the works of W. Broady and Sons Ltd.

LARGE FURNACE INCREASES FACILITIES AT IMPERIAL CHEMICAL INDUSTRIES LIMITED

Titanium Melting

ONE of three furnaces supplied by W. C. Heraeus G.m.b.H. (Western Germany) for the production of double-melted ingots by the consumable electrode arc melting process, the largest titanium melting furnace in Europe has gone into operation at the Kynoch works of I.C.I. (Metals Division) at Witton, Birmingham. The furnaces were delivered in January, and the first one-ton ingot was produced a little over two months later. Within a few days, an ingot, weighing 4,200 lb.—the largest ever produced outside the U.S.—was successfully melted.

The availability of such large ingots offers two important advantages:

(1) It widens the scope of fabricating techniques which can be applied to titanium. In particular, it makes possible for the first time the rolling of slab into long-length coils by strip rolling techniques without the necessity for welding small coils together.

(2) It increases yield by decreasing surface/volume ratio. Any reduction in process scrap is, of course, a most significant factor, because titanium is still a relatively expensive metal.

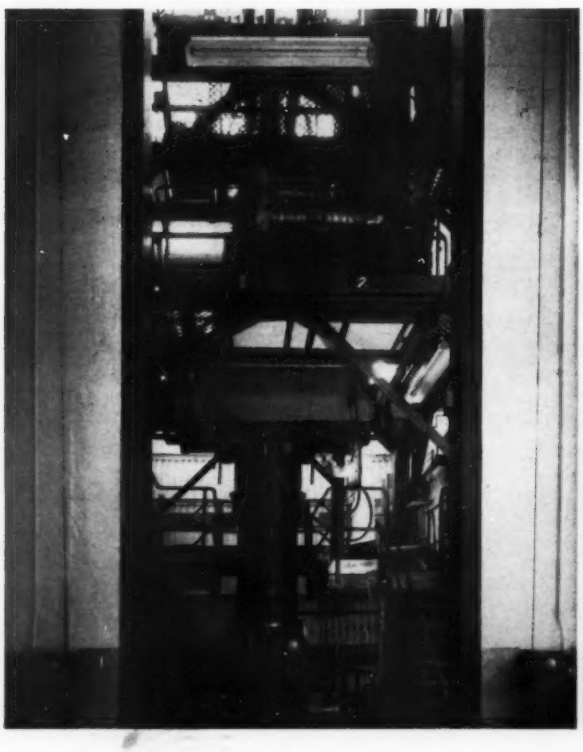
The new equipment embodies several interesting features. The melting current employed is higher than has ever before been used for this purpose in Europe, which facilitates more complete melting and results in ingots of improved homogeneity and better surface quality. The furnace will normally operate with a high degree of vacuum, a pressure of under 10 microns being maintained throughout a melt. Facilities are also provided for melting under a reduced pressure of an inert gas, should this be required.

Particularly useful are features which reduce "down time" between melts and effect big improvements in furnace utilization. One such device enables the first-melt ingot to be withdrawn into the upper part of the furnace and held in vacuum while the larger-diameter crucible necessary for the second melt is fitted. Another allows the second-melt crucible, containing the double-melted ingot, to be sealed by a plate valve and withdrawn from the furnace for cooling, so that the furnace can immediately be prepared for another melt.

To ensure safe working, all operations are carried out by remote control, and the furnaces are installed in massive reinforced concrete cubicles affording complete protection. In the control room, optical systems give operators a clear view of the furnace interior throughout the melting process. Other instruments record essential technical data at all stages, and incorporate a system of fault indication and location. The effect of such completely protective measures is to allow considerably greater flexibility in melting operations, itself an important advance in the technology of titanium melting.

It is less than three years since I.C.I. commissioned Britain's first titanium melting plant. Since then, technical knowledge has accumulated so rapidly that the company has twice replaced its entire complement of melting furnaces. I.C.I. is, however, satisfied that furnace development has now achieved stability, and that the present equipment will meet all foreseeable requirements for a much longer period.

In 1955, eighteen furnaces were needed for an output of 1,500 tons a year; to-day, three are sufficient to produce over 2,000 tons a year. This increased capacity, together with the availability of high-quality ingots in larger sizes, is likely to open up still further outlets for titanium.



Left : The recently installed vacuum melting furnace for the production of 4,200 lb. titanium ingots. The furnace, built by W. G. Heraeus G.m.b.H., uses a consumable electrode arc for the double melting process employed

Below : The control room for the titanium melting installation gives operators a clear view of the furnace interior, and all data are recorded by the control instruments

Finishing Supplement

Automatic Plating for Automobile Components

BEGUN two years ago, the new plating plant at Vauxhall Motors Ltd., Luton, is now nearing completion. Part of a programme for stepping up production from 130,000 to 250,000 vehicles per year, this electroplating installation, claimed to be the largest in Europe, comprises two straight-through fully automatic installations (one for copper and the other for nickel and chrome deposition), two subsidiary installations (one automatic and one semi-automatic) for zinc plating, and two automatic polishing machines. The design and construction of these installations have been carried out by W. Canning and Co. Ltd., Great Hampton Street, Birmingham, 18.

For the copper, bright nickel, and chrome plating of steel pressings the installation is in two sections. The first section applies a heavy copper deposit, which is polished prior to being conveyed back to the bright nickel and chrome section of the installation, from which components are passed directly to the assembly lines.

Each unit is designed to handle 100 jigs/hr., each jig being loaded with approximately 8 ft² area of components. The total throughput is 200 jigs/hr., equivalent to 1,600 ft² of plated work.

In order to ensure complete automation as far as plants of this type have developed, duplex main drives are used to reduce the drag load on the main conveyor, and automatic lubrication is provided for conveyor chains and contact track. Automatic load and off-load have been incorporated. Provision is made for chemical make-up remote from the process tanks, and general control of the plant is operated from control rooms built on the upper platform.

The heavy copper plating plant has an overall length of 217 ft. 6 in., an overall width of 60 ft., and an overall height of 23 ft.

The bright nickel and chrome plant is 262 ft. long, 60 ft. wide, and 23 ft. high.

Heavy Copper Plating

The straight-through automatic heavy copper plating plant occupies approximately 13,000 ft² of floor space. Two rows of 22 process tanks lie parallel to each other 9 ft. apart.

Around the plant is erected a massive steelwork structure which supports the conveyor system, rectifiers, transformers, and storage tanks, and the platform and cat-walks for the plant operators.

A conveyor system runs between them, supporting a series of flight bars which extend over the tops of the tanks on either side. There are 138 flight bars spaced on a twin strand link conveyor and held in position by flared U-shaped plates attached to links in the conveyor. During plating, the bars are carried by the conveyor on hard drawn, high conductivity copper track above the tops of the process tanks from one end of the plant to the other. At the discharge end, the conveyor carries the flight bars upwards and back over the length of the plant to the loading end.

The conveyor system is operated by a system of 23 elevator towers spaced between the parallel rows of tanks. The towers are fitted with a carriage, and when a flight bar approaches a transfer station a limit switch is operated. This sets in motion the elevator motor. The carriage is controlled and moves up the tower, lifting the flight bar with it. At the end of the travel a limit switch operates and checks the movement. The next part of the operation is to slide the flight bar forward. This is done by a separate system, and the distance moved is sufficient to clear the lips of the abutting tanks and allow the jigs to be lowered cleanly into the next process tank. When the flight bar reaches this position, the lift motor reverses and the elevator is lowered, placing the bar back on the moving conveyor—the speed of which is 12½ in/min.

Serving the main conveyors are auxiliary conveyors. These are of a special cycle controlled type. Their function, in addition to feeding the process conveyor with loaded jigs and receiving the plated work, is to present and accept the jigs at the automatic loading and unloading machines. Finished work from the polishing section is passed to the loading bays. There are five bays, and each handles a particular group of articles. The auxiliary or feeding conveyor has a series of trolleys which are brought on loops into the loading bays. Here they are loaded with jigs which have been filled with the polished work. They are then moved through the loops on to the conveyor, which transports them to a storage point before the loading unit. At the correct time, a pulse is received from the plant control and four jigs are carried by the trolleys to the loading position. At the correct point they are stopped, and four pairs of arms from the loading unit lift the jigs off the conveyor and place them on the flight bars of the plating plant conveyor.

The empty trolleys then by-pass the plating plant and are brought to the discharge end of the process line. Meanwhile, four jigs of processed work are at the discharge end of the plating line. These are lifted by the unloading unit, rotated through 180° and placed upon the trolleys of the conveyor. At a signal, the trolleys are moved along the conveyor to the unloading bay. Each trolley selects its appropriate bay, where the components are removed from the jig. The trolley and empty jig then return to the line and pass through to the loading bay.

The plating sequence of the heavy

TABLE I—HEAVY COPPER DEPOSITION

Ref. No.	Process	Immersion Time (min.)	Tank Lining	Stage
1	Power spray cleaner	2¾	Rubber	Cleaning
2	Power spray swill	½	,,	
3	Electrolytic cathode cleaner (Anodax)	2¾	,,	
4	Cold electrolytic cathode cleaner (Anodax)	2¾	,,	
5	Warm swill and spray	½	,,	
6	Dragout	½	,,	
7	Cold swill and spray	½	,,	
8	Acid dip	½	,,	
9	Dragout, swill and spray	½	,,	
10	Dragout, swill and spray	½	,,	
11	Cold swill and spray	½	,,	
12	Cyanide dip	½	,,	
13	Cyanide copper plate (Cuprax)	10	,,	Cyanide Copper Plate
14	Dragout, swill and spray	½	,,	
15	Dragout, swill and spray	½	,,	
16	Cold swill and spray	½	,,	
17	Cold swill	½	,,	Acid Copper Plate
18	Acid copper plate (Sulfast)	60	,,	
19	Dragout swill	½	,,	
20	Dragout swill	½	,,	
21	Cold spray and swill	½	,,	
22	Hot swill	½	Lead	

Thermostatic control is fitted to all heated tanks

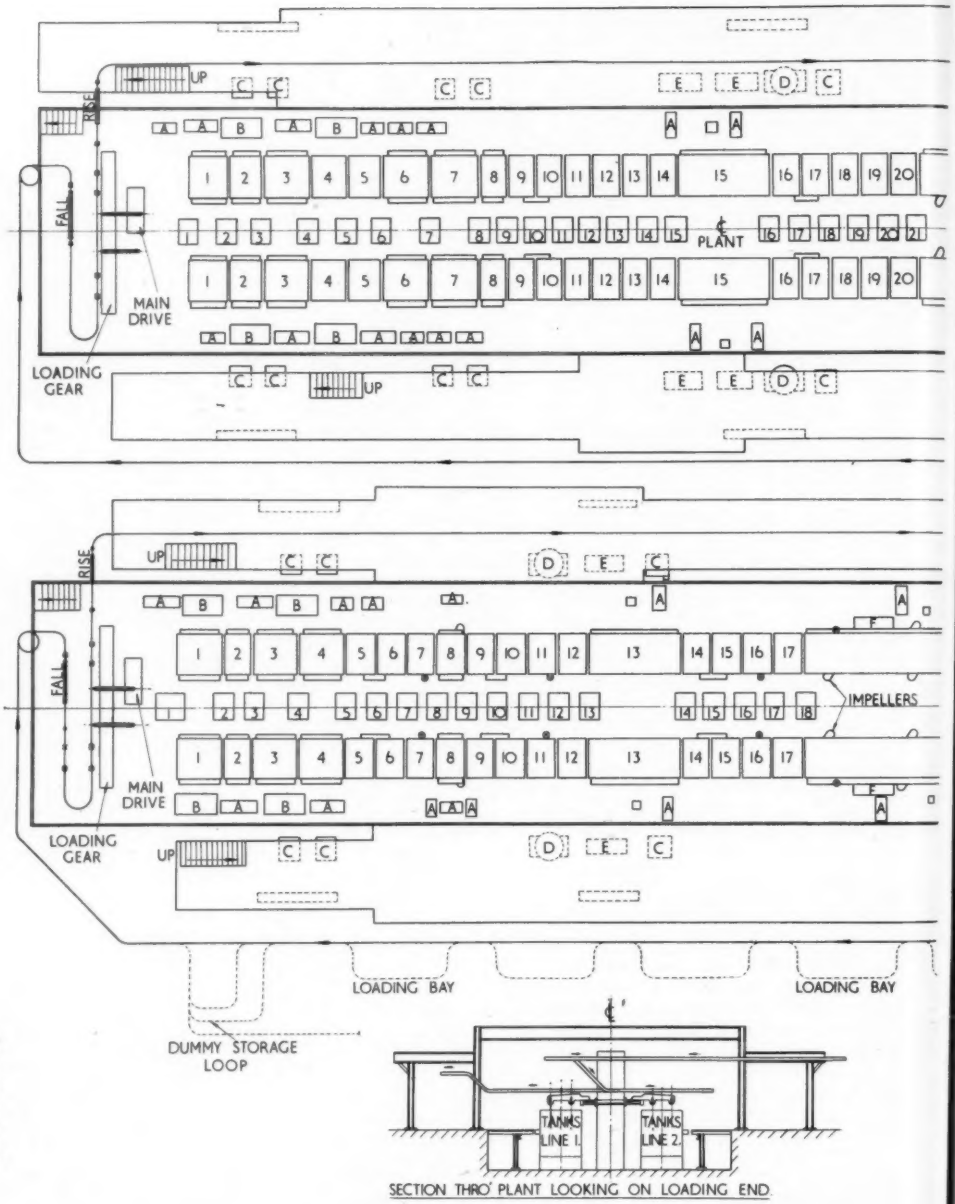
A—Pump
B—Sump tank
C—Mix tanks
D—Wash tank
E—Filter
F—Plate out

Upper diagram:

1—Caustic anodic clean
2—Power spray swill
3—Power spray clean
4—Neutralize
5—Spray swill
6—Cathodic hot clean
7—Cathodic cold clean
8—Anodic clean
9—Dragout
10—Dragout
11—Cold swill auto spray
12—Acid dip
13—Spray swill auto spray
14—Cyanide dip
15—Cyanide copper
16—Dragout
17—Dragout
18—Spray swill auto spray
19—Acid dip
20—Spray swill
21—Bright nickel plate
22—Dragout
23—Dragout
24—Dragout auto spray
25—Inspect
26—Chrome
27—Dragout
28—Dragout
29—Neutralize
30—Spray swill auto spray
31—Hot swill
32—Spray swill auto spray
33—Hot swill

Lower diagram:

1—Power spray clean
2—Power spray swill
3—Hot cathodic alkaline cleaner
4—Cold anodic alkaline cleaner
5—Warm swill spray
6—Dragout
7—Cold swill
8—Acid dip
9—Dragout
10—Dragout
11—Cold swill auto spray
12—Cyanide dip
13—Cyanide copper plate
14—Dragout
15—Dragout
16—Cold swill auto spray
17—Cold swill auto spray
18—Acid copper plate
19—Dragout
20—Dragout
21—Cold swill auto spray
22—Hot swill



SECTION THRO' PLANT LOOKING ON LOADING END

Diagram showing lay-out of plant and ancillaries at Vauxhall Motors Limited. The upper diagram shows the automatic copper—nickel—chrome plant. The lower one shows the automatic acid copper plating plant.

copper deposition plant is detailed in Table I.

Stored in three rubber-lined tanks are 17,000 gallons of copper solution. These solutions are passed to the process tanks by rubber-lined pumps through filters which can deal with 12,000 gal/hr. of solution. In addition, there are eight mixing tanks for the various cleaning and other solutions used in the plant.

Each filtration pot can deal with 1,000 gal/hr. of solution, and there are 20 filtration pots in the system, located at the side of the plant. Each section of the filtering system is complete with its own wash deck and hoist for maintenance purposes. The system has provision for filtration with activated carbon, if required.

As the area of open solution in the tanks is so large, it is necessary to take precautions against atmospheric dust settling on the surface, hence the elaborate filtration arrangements.

The current available for the electrolytic processes totals 71,000 amp. Current is taken from the mains and transformed by banks of oil-immersed metal plate rectifiers. There are 20 rectifiers, 12 of them motorized, giving infinitely variable control. Current is fed to process tanks via aluminium busbars. Current for the electrolytic operations is passed to components via the flight bars which, in turn, collect current from the H.D.H.C. copper track beside the main conveyor.

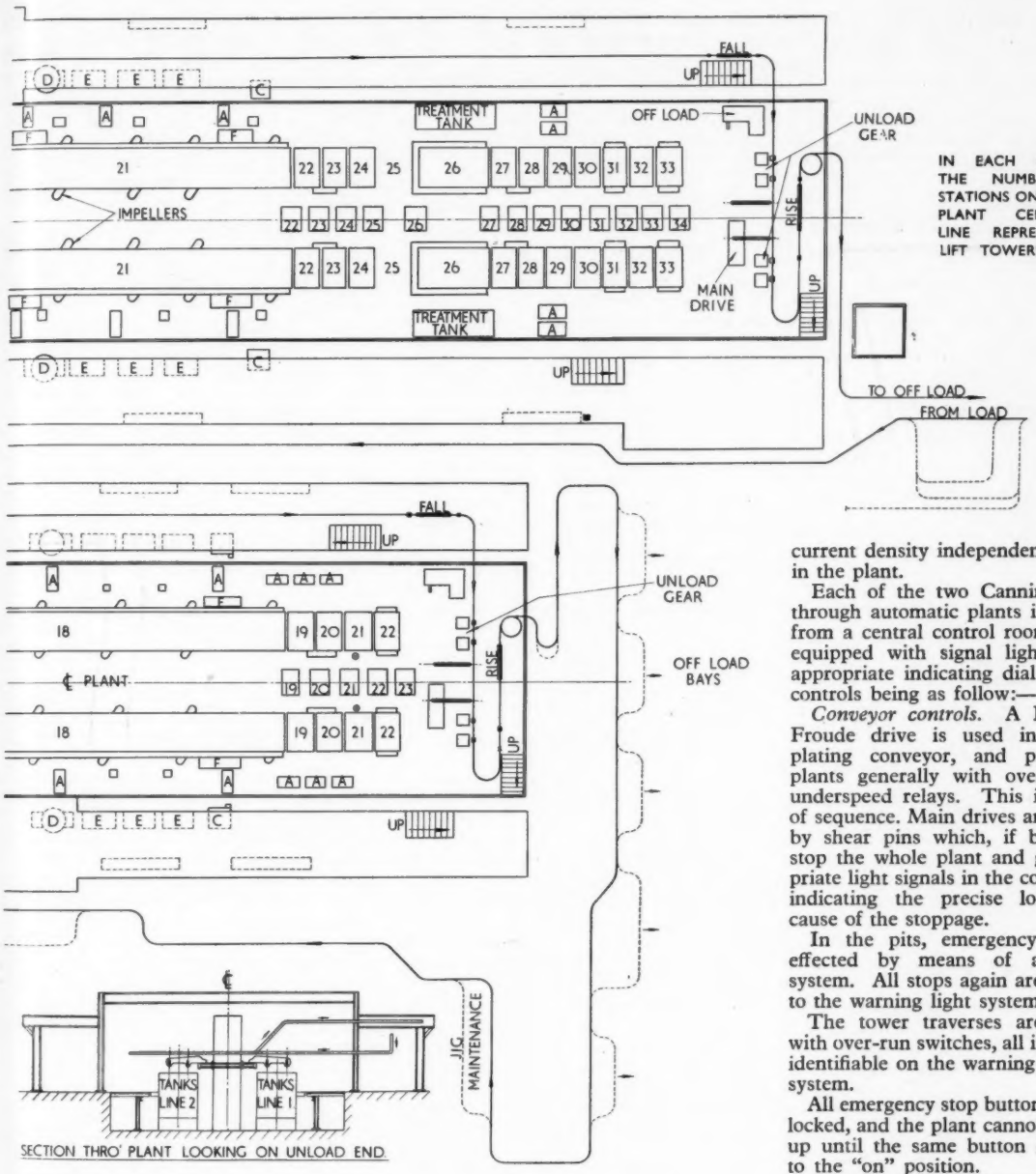
The entire electrolytic installation is controlled at one point at the central control panel. The conveyors, pumps and filtration equipment have separate control points on the panel.

Nickel and Chrome Plating

The design of the nickel and chrome plant is, in general, the same as the heavy copper installation. It is slightly larger, and occupies approximately 16,000 ft² of floor space. The plating tanks are in two parallel rows, 9 ft. apart; 32 tanks make up each line.

Arrangement of the conveyor system is identical, and it uses 168 flight bars. The plating installation is also served by auxiliary conveyors, and has automatic loading and unloading units.

Current from the rectifiers totals 111,000 amp. Output of the plant is 100 jigs/hr., each jig having 8 ft² of



IN EACH CASE THE NUMBERED STATIONS ON THE PLANT CENTRE LINE REPRESENT LIFT TOWERS

cathode area, giving 800 ft²/hr. of plated surface.

The plating sequence of the nickel and chrome plant is given in Table II.

The conveyor system is fitted with 34 lift towers, spaced along the 9 ft. passage between the two rows of process tanks. Operation is the same as the conveyor on the copper plating plant.

The auxiliary conveyors are the same as the conveyors serving the copper plant, and present and accept loaded jigs at the automatic loading and unloading machines.

There is storage for 13,000 gal. of nickel solution in three rubber-lined tanks. The solution is passed to the process tanks by rubber-lined pumps through filters capable of handling 6,000 gal/hr. of solution. There are 21 mixing tanks for the cleaning and plating solutions.

An interesting feature of the nickel filtration system is the removal of metallic solution contaminants by low current density plating out. This comprises two "blister" compartments on the main tanks through which the solution is continuously circulated.

Current totalling 111,000 amp. is supplied by 30 rectifiers—12 being motorized to give infinitely variable control. The entire electrolytic installation is controlled at one point on the central control unit. Conveyor pumps and filtration equipment have separate control points.

Automatic current density control is incorporated which maintains constant current density independently of work in the plant.

Each of the two Canning straight-through automatic plants is controlled from a central control room, which is equipped with signal lights and the appropriate indicating dials, the main controls being as follow:—

Conveyor controls. A Heenan and Froude drive is used in the main plating conveyor, and protects the plants generally with overspeed and underspeed relays. This is a control of sequence. Main drives are protected by shear pins which, if broken, will stop the whole plant and give appropriate light signals in the control room, indicating the precise location and cause of the stoppage.

In the pits, emergency stops are effected by means of a trip-wire system. All stops again are connected to the warning light system.

The tower traverses are equipped with over-run switches, all immediately identifiable on the warning panel light system.

All emergency stop buttons are interlocked, and the plant cannot be started up until the same button is switched to the "on" position.

Filter controls. Pressure switches indicate when filters are approaching the choking stage.

Solution levels. A simple solution level switch is fitted to tanks and, when the level falls below the required level, a warning bell rings and a light appears on the control panel, indicating that the tank requires attention.

Temperature control in chrome tanks. Thermostatic controls (in a chilled water tank) and flow indicators are fitted to the chrome tanks; 20,000 amp. are available for each chrome tank. To control the temperature rise, refrigeration equipment is installed. The heating and cooling of the chrome solution is controlled by an external heat exchanger, through which the chrome solution is pumped.

Heat exchangers. A motorized valve

TABLE II—NICKEL AND CHROME DEPOSITION

Ref. No.	Process	Immersion Time (min.)	Tank Lining	Stage
1	Caustic anodic cleaner (Anodax)	1¾	—	
2	Power spray swill	½	Lead	
3	Power spray cleaner (Anodax)	3	—	
4	Neutralize	1¾	Rubber	
5	Spray swill	1¾	,,	
6	Cathode hot cleaner (Anodax)	3	—	
7	Cathode cold cleaner (Klenewell)	3	—	
8	Anodic cleaner	½	Rubber	
9	Dragout	½	,,	
10	Dragout	½	,,	Cleaning
11	Cold swill	½	,,	
12	Acid dip	½	,,	
13	Spray swill	½	,,	
14	Cyanide dip	½	,,	
15	Cyanide copper	10	,,	
16	Dragout	½	,,	
17	Dragout	½	,,	
18	Spray swill	½	,,	
19	Acid dip	½	,,	
20	Spray swill	½	,,	
21	Bright nickel (Gleamax)	45	,,	
22	Dragout	½	,,	Nickel Plate
23	Dragout	½	,,	
24	Spray swill	½	,,	
25	Inspection			
26	Chrome plate (Zonax Chrome)	7	Lead lined & Tiled	
27	Dragout	½	Lead	
28	Dragout	½	,,	
29	Neutralize	½	,,	Chrome Plate
30	Spray swill	½	Rubber	
31	Hot swill	½	Lead	
23	Spray swill	½	Rubber	
33	Hot swill	½	Lead	

The tanks which contain the heated solutions are thermostatically controlled

is incorporated which is connected to one side of the pump motor. Should the pump fail, the process heat system will be turned off automatically by an alternative electrical circuit operating the motorized valves.

The plants have been designed to conserve water and although there are many water swills, they are arranged, wherever possible, in counterflow.

Although a completely new drainage system, leading to a new trade effluent treatment plant some three-quarters of a mile away, has been installed to serve these plants to minimize the effluent problem, non-cyanide cleaners are used wherever possible, and double drag-outs are installed. The drain channel system is laid so that acids and cyanides are kept separate.

Zinc Plating

Zinc plating is carried out in two plants. One is a heavy return type electro-hydraulic automatic unit; the other, a "Submatic" semi-automatic barrel plant.

The return type automatic unit is a two work line installation, 70 ft. in length. It has an output of 120 work jigs/hr., and is engaged on plating steel brake fittings. The operating mechanism is carried by a steel centre structure, and the plating tanks are ranged round. Lift, lower and traverse are by hydraulic gear which is electronically interlocked to ensure perfect timing of the plating process. The whole plant is under the supervision of one operator, who loads and unloads the jigs of work.

Electrical power for the process is supplied by rectifiers, which have a total output of 16,500 amp. An overhead platform, positioned at the side of the plant, carries the solution storage equipment and fume extraction fans. Below the platform are the rectifiers, filtration equipment and switchboards.

The "Submatic" plant for zinc plating is 36 ft. long and comprises 10 separate tanks in line in a steel frame. It is for zinc plating a wide range of small components too small for handling through the automatic unit.

Four ebonite barrels, each of 100 lb. capacity, are used for processing the work through line. The barrels are lifted and traversed by a monorail hoist fitted with a pendant control.

Drive is by chain from a master motor unit to each barrel station. On lowering the barrel to its process tank, the driving gear engages automatically. Each station has individual clutch control, thereby enabling barrels to be engaged and disengaged individually.

Three barrels can be processed simultaneously in the zinc tank and two in the hot cleaner. At these stations each barrel has individual current control.

Current for the electrolytic processes totals 2,500 amp. Process timing is arranged to give both audible and visual warning. Exhaust equipment is fitted to those tanks which fume, and the barrels are also exhausted while in the lifted position by an exhaust lip on the half hood. After processing, the barrels are discharged into a hopper in the hot swill tank. The hopper, in turn, discharges into one of the two centrifugal dryers for final drying.

The zinc storage tanks for this plant have a capacity of 800 gal. It is on the steel structure which is common to both the "Submatic" and the zinc return plant. Filtration equipment and switch gear are below the storage tanks.

An electric overhead monorail hoist is installed above the process tanks to lift and hoist barrel loads of components from one process tank to the next.

Automatic Polishing Machines

Two automatic polishing machines have been supplied for polishing hub caps after copper plating, before nickel and chrome plating takes place. These machines are 96 in. diameter, 10 spindle units. Each unit has two motors —one for indexing the table, the other for driving the spindles. Nine spindles rotate continuously while the tenth spindle, which comes into the loading/unloading station, is automatically disconnected for changing the workpiece.

The indexing motion is timed to allow each polishing operation to be fully completed. At the end of the operation, the polishing head is automatically raised by a pneumatic system, the table indexes to the next station, and the head is then lowered and polishing recommences.

There are eight polishing heads to each machine. These are 7½ h.p. light follower units, each of which is fitted with automatic polishing composition applicators.

Obituary

Mr. H. N. Allday

WE regret to record the death of Mr. Henry Nelson Allday, joint managing director of J. Betts and Sons Ltd., smelters and refiners, of Birmingham. He had been with the firm more than 50 years and became joint managing director about five years ago.

Mr. W. J. G. Sperryn

IT is with regret that we record the death of Mr. William John Goldsworthy Sperryn, of the Birmingham firm of brass founders, Sperryn and Co. His association with the firm covered 58 years. He retired from the position of managing director in 1948 but remained on the board. Mr. Sperryn was a past-president of the Birmingham Rotary Club and took a great interest in local health and welfare services.

Industrial News *Home and Overseas*

Tin Markets

Whatever internal adjustments there may be within the framework of the restriction scheme at the forthcoming meeting of the International Tin Council, it is most unlikely that, under present conditions, the flow of metal from the producing countries as a whole will be allowed to increase. It is equally improbable that the Buffer Stock Manager, as suggested by some, will, in the foreseeable future, run out of funds with which to buy tin on the market at the £730 level. These points are made in their April review of the tin market by A. Strauss and Co.

Although the quantity of metal in his possession now must amount to about 20,000 tons, he has in hand sufficient money from the earlier contributions of the producing countries to purchase another 3,500 tons. On top of that, he can draw on the "special fund" which it was agreed to establish at the last meeting of the Council and which he has now received.

It is not known how much this amounts to, or what tonnage of tin it will enable him to buy, but now that the pipeline flow is drying up and the 40 per cent export cut will soon have its full impact on current supplies, there should be little, if any, surplus for him to take up.

Commenting on press reports of the possibility of Chinese tin of 99·9 per cent purity being registered on the London Metal Exchange, A. Strauss and Co. say that small quantities of Chinese tin of 99·9 per cent are known to have been exported to Western Europe, and a tentative approach has, in fact, been made to the committee of the London Metal Exchange for Chinese refined tin to be registered.

Chemical Analysis

A joint meeting of the Midlands Section of The Society for Analytical Chemistry with the East Midlands Section of the Royal Institute of Chemistry is to be held at 7.30 p.m. on Thursday, April 24, in the College of Art and Technology, Leicester. A Paper entitled "Developments in the Use of Redox Indicators," by R. Belcher, Ph.D., D.Sc., F.R.I.C., F.Inst.F. (Birmingham University), will be presented and discussed.

Nuclear Engineering Equipment

Construction of the first of twelve heat exchangers for the Bradwell Nuclear Power Station is nearing completion at the Thornaby Works of **Head Wrightson and Co. Ltd.**

These heat exchangers, fabricated in $1\frac{3}{16}$ in. thick steel plate, are 95 ft. long, 20 ft. in diameter, and weigh over 200 tons. When the first heat exchanger is completed in May of this year it will be launched into the river Tees from Head Wrightson's slipway and towed round the coast to Bradwell at the mouth of the Blackwater Estuary in Essex. On arrival, the exchanger will be landed and lifted on to its foundations by the Goliath crane recently completed.

Foundry Merger

More than 100 years old, the Isca Foundry Co. Ltd., of Newport, Monmouthshire, manufacturers of railway materials, switches and crossings, buffer stops, turntables, pressed steel chairs and iron castings, etc., has been taken over by **Eagre Construction Co. Ltd.**, Scunthorpe, Lincs.

Colonel W. L. C. Phillips, one of the recently retired directors of the "Isca," has been appointed manager, with Mr. J. Thomas as secretary. Before this, Mr. Thomas was an accountant with Eagre. Apart from these appointments, no further changes in management or staff of the new company are planned for the time being.

New Premises Completed

New premises at Edgware that have been built for **E. H. Jones (Machine Tools) Limited** are now completed.

The accommodation consists of a large warehouse for used machines and a showroom that is equipped for working demonstrations. Provision has been made for the introduction of a spares service for CVA automatics and dieing presses.

Their new London area address is 48 High Street, Edgware, with the telephone number Edgware 4488-9.

Precious Metals

No signs of any revival of activity in free platinum in the U.K. are yet discernible, according to dealers, and hopes that business would pick up after the Easter holidays have not so far been realized.

Reports say that there is not a great deal of platinum on offer and, with no particular selling pressure at the moment, prices are still nominally indicated at £23 to £24 per troy ounce. Noting the softness of the dealer market in the United States, some London trade quarters believe that the small amount of business being effected there recently has been at prices well below the 68 dollars per oz. level. Meanwhile, the price quoted by the two leading refiners in the U.K. to their regular customers still stands at £26 15s. 0d. per troy oz.

Other precious metals and prices remain nominally unchanged, with palladium indicated at £7 10s. 0d. per troy oz., iridium £23 to £25, osmium £19 to £21, ruthenium £14 10s. 0d. to £15 10s. 0d., and rhodium £40 to £41.

New Branch Office

Moving to new quarters, the Hull branch office of **British Insulated Callender's Cables Limited** will be located at 49 Mytongate, Hull, as from April 21, 1958. The telephone numbers will be 16470 and 16367.

Midland Trade

Activity in the motor trade is the highlight of industry in the Midland area, and the successes achieved in the American market mean full employment for many workers, not only in the industry itself but in the many trades which supply either raw materials or semi-manufactured products. In other sections of the metal-using trade the picture is not so bright. There is no improvement yet in the demand for metal fittings used in the building industry. Makers of electrical equipment are very active, particularly in work for new power stations.

In the iron and steel trade, the supply of heavy steel plates still lags behind demand, but in other branches the position is much easier. Orders on forward account are not very substantial beyond the end of the half year, except in regard to sheets, which are very active due to the prosperity of the motor trade. Stocks of foundry pig iron are heavier because of the quietness in the light castings trade. Engineering industries generally are well placed for business, particularly amongst builders of railway equipment.

A Removal

It has been announced by **Barlow-Whitney Ltd.** that their Midlands office has now been situated at 44 Queen's College Chambers, Paradise Street, Birmingham, 1. The telephone number is Midland 6897, and this address is the headquarters of Mr. H. Melrose, A.M.I.E.E., the company's Midlands area manager.

New Limited Company

After 31 years of trading, **Mr. H. Landseer-Bailey,** ingot metal manufacturer, has formed his business into a private limited liability company with the title H. Landseer-Bailey Ltd. Mr. Landseer-Bailey will be chairman of the company, and his co-directors will be Mr. Robert John Allen, Mr. Edward Henry Drew, and Mr. Francis Wilfred Bailey, all of whom have been with the business for many years.

Small Tools Expansion

An additional factory—their fifth—has been acquired in the Slough Trading Estate by **Wolf Electric Tools Limited,** London.

The new premises, which will make available an extra 15,350 ft² of floor space and are to be used for promoting planned technical developments, provide further proof of the company's vigorous policy.

Central Purchasing

A Central Buying Department, located at the company's head office in London, has been established by **Northern Aluminium Company Limited** to co-ordinate purchasing policies within the company and to negotiate for major items of equipment and bulk supplies of material. Mr. D. A. Corbett-Thompson, formerly export sales manager, has been appointed chief purchasing officer.

The buying departments of the company's three works at Banbury, Birmingham, and Rogerstone, Mon., will continue to function.

Compressor Installations

Seven Atlas Copco AR9 compressors are now in service at the Luton works of Vauxhall Motors Ltd, this being one of the largest industrial compressor installations supplied by the **Atlas Copco Organization.** These compressors were ordered and installed as part of Vauxhall's newly completed £36 million expansion programme.

All seven compressors, which have a combined free air delivery amounting to 22,540 ft³/min., have been installed in a new compressor house built adjoining the three main workshops using compressed air. Each installation comprises an AR9 compressor with 6·6 kV Bruce Peebles

synchronous over-hung motors with separate excitation, pulsation damper, Atlas water-cooled aftercooler, and an air receiver 6 ft. diameter by 17 ft. high.

Bullion Activity in March

The shortage of spot silver persisted into the early part of March, and prices improved to 76⅞d. for spot and 76⅞d. for forward by March 10, according to reports from Sharps, Pixley and Company. Thereafter, with fresh arrivals easing the spot position and rather less demand for industrial silver, prices fell gradually until 76d. for spot and 75¾d. for forward were quoted from March 19 to March 24. Some improvement in demand for both industrial and exportable silver resulted in ¼d. rise for both deliveries from March 25 to 28, but this was lost on the last day of the month, the quotations being back to the previous level of 76d. and 75¾d. respectively. The market closed quiet and uncertain.

Throughout the whole of March the price of gold in London remained very steady at a level of just over 249s., the highest being 249s. 5d. on the 6th and the lowest 249s. 2¼d. on the 18th. During this period the dollar quotation remained steadily at a level above $35·08, and towards the end of the month began to firm up on some buying when supplies were limited — $35·11 to $35·12 being quoted on March 27. The Bank of England was not at any time a very free seller, gold at the daily fixing being "rationed" more often than not. The usual selling by Central Banks when levels reach about $35·09 was not forthcoming, and it is reported that this may be because some institutions may for the time being prefer to keep their balances in gold rather than in dollars.

Industrial Welfare Conference

Delegates to the thirty-fifth week-end conference for foremen and forewomen, organized by the **Industrial Welfare Society,** to be held at the Grand Hotel, Brighton, from May 16 to 19, will consider among other topics, the foreman's relationship to the nation's economic problems, which will be studied by Mr. J. Campbell Fraser (Dunlop Rubber Co. Ltd.). Mr. H. J. Hebden (Venesta Ltd.) will consider how changes in the nature of industrial discipline affect the foreman.

The education and training officer to the Central Electricity Generating Board, Mr. J. H. Ramsden, will examine the effects of work study on the foreman's responsibilities.

The role of the shop steward will be the subject for Mr. John Holland, I.W.S. assistant director; and the impact of modern management upon the foreman will be assessed by Mr. John Marsh, I.W.S. director.

Italian Factory

New factory premises, jointly owned by **Edwards High Vacuum** and S.A.E.S. (Societa Apparecchi Elettrici and Scientifici S.p.A.) through the subsidiary, Edwards Alto Vuoto A.p.A., have been opened in Milan, Italy.

Indian Visit

Flying to India on Monday, April 21, for a two-week visit is Mr. T. S. Horan, director of **Megator Pumps and Compressors Ltd.** He will be visiting the company's agents in Calcutta, and various commercial and industrial concerns.

The company have an active export trade to India, one of the most recent contracts being for equipment to be used in the projected new steel mills at Durgapur.

Industrial Safety

This year's National Industrial Safety Conference of the Royal Society for the Prevention of Accidents, which takes place at Scarborough from May 9-11, has for its theme "Works Tidiness"—a convenient title covering such safety essentials as efficient planning of the job, safe means of access, and the correct handling of goods of all kinds.

The various aspects of the problem are to be dealt with in a selection of Papers, and the chairman of the business sessions will be Mr. H. E. Phillips, chief safety engineer of Vauxhall Motors Ltd. The Society's President, Sir Howard Roberts, C.B.E., D.L., J.P., will deliver the presidential address, and the opening address will be given by W. H. Garrett, M.B.E., B.Sc., Ph.D., J.P., personnel director of Monsanto Chemicals Ltd.

The full programme of Papers is as follows:—Saturday, May 10: "Planning the Job for Safety," by J. B. Kitchin; "Manual Handling and Lifting Methods," by George Hickling; "Moving Goods Safely About the Factory," by A. J. Goodall; "Portable Means of Access," by J. McGuire. Sunday, May 11: "Safe Handling of Loads," by H. H. Simmonds.

The conference will conclude with a "Question Time," during which written questions handed in by delegates will be dealt with by a panel of lecturers.

Foundry Equipment

An export consortium comprising five British manufacturers, each concentrating on a particular section of the foundry machinery and foundry plant field has been formed under the name **British Consolidated Foundry Plant Manufacturers.**

The group consists of: Consolidated Foundry Plant Limited, Acme Conveyors Limited, Metalectric Furnaces Limited, Paterson Hughes Engineering Company Limited, The Coleman-Wallwork Company Limited, and Tilghman's Limited.

There is little overlapping of interests between the five companies and they have, accordingly, pooled their technical resources and their export sales effort in order to obtain greatly increased efficiency and strength.

Apart from the sale of a large number of standard machines, the group is most interested in tendering for complete new mechanized foundries, for the extension and modernization of old ones. It co-ordinates its design, manufacture and delivery of such complete schemes, as well as shipment and financial arrangements. Such co-ordination is provided by a company, Consolidated Foundry Plant Ltd., recently registered for the purpose. It has an experienced export staff, backed by five technical advisers, one appointed from each member company.

Design Centre Competition

Prizes awarded in a national competition held to promote first-class design in the gold, silver and jewellery industries, and to encourage free-lance designers, employees, instructors and students in the jewellery trade, and organized by the **Design and Research Centre,** will be presented at 5.45 p.m. on Monday, April 21, at the Goldsmiths Hall, by the Prime Warden of the Worshipful Company of Goldsmiths (B. J. J. Tyldesley, Esq.) in the presence of the Lord and Lady Mayoress of London.

Besides the winning designs at the private view, there will also be some 150 designs on show out of a total of nearly 300. The exhibition will be open to the public from Tuesday, April 22, until Friday, April 25, and will then move to Birmingham, May 6-9, to Sheffield, May 20-30, to Glasgow, June 10-13, and to Cheltenham, June 24-27.

It is hoped that this competition will become an annual event.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 18,165 tons, comprising London 5,796, Liverpool 11,294, and Hull 1,075 tons. Copper stocks totalled 19,532 tons, and comprised London 11,334, Liverpool 7,008, Birmingham 965, Manchester nil, Swansea 175,, and Hull 50 tons.

Foundrymen's Conference

Details of the forthcoming annual conference of **The Institute of British Foundrymen,** at Buxton from May 13-16 next, are contained in a booklet just issued. The full programme is outlined and brief descriptions of the works to be visited are given.

Canadian Aluminium for India

Canada has agreed to supply 10,000 tons of aluminium to India as assistance under the Colombo Plan, according to reports from New Delhi. In addition, 7,500 tons of copper and 500 tons of nickel are being given as Colombo Plan aid. The total value of these metals at present prices is estimated at 57,500,000 rupees.

Official sources said that, in the event of prices going up, the quantity of metal to be imported would be modified to keep it within the above limit. The metals are to be imported as soon as possible by Indian consumers.

S.I.M.A. Canada Team Returns

On the return of the team of **Scientific Instrument Manufacturers Association** which has toured Toronto, Ottawa and Montreal, the leader, Mr. Laurie Woodhead, suggested that manufacturers could do more to sell to Canada, especially operating as groups. Reports from individual firms who are members of S.I.M.A., suggest, however, that good business is being done. Hilger and Watts Ltd. have opened up a market for spectrographs, polychromators and spectrophotometers; Unicam Instruments Ltd., also, have sold their SP100 spectrophotometer there, and both Fielden Electronics Ltd. and Sunvic Controls Ltd. report promising developments.

Nuclear Engineering

An export order for 160 fuel element shield plugs, valued at £21,000, has just been completed by **Savage and Parsons Ltd.** (Watford, Herts.). The plugs will be used in the experimental reactor at Lucas Heights, near Sydney. They are similar in design to those produced for the Dido and Pluto reactors at Harwell, and for the DMTR reactor at Dounreay.

A further export order for 130 similar plugs has also been received from Denmark.

Each fuel element plug is 4 ft. 6 in. long and $4\frac{1}{4}$ in. diameter. The body is a titanium-stabilized stainless steel tube filled with concrete and iron shot, to a density of 350 lb/ft^3, and a 4 in. layer of lead.

Also housed in the main tube are three stainless steel "purge" tubes, through which air or gases can be cleared from around the fuel element, and a centre plug which can be withdrawn to facilitate the removal of water and chemicals from the core of the reactor.

The fuel element and cooling sheath is attached to the bottom of the plug by a clamping ring.

I.E.A. Exhibition

ON Wednesday last the Instruments, Electronics and Automation Exhibition was opened at Olympia, London, and will remain open until Friday next, April 25. Quite a number of exhibits should be of interest to readers of this journal, and from the details of some of these exhibits which have been supplied to us we are able to give the following notes:—

On Stand No. 202, **Baldwin Instrument Co. Ltd.** are showing such instruments as the Atomat nucleonic transmission thickness gauge with automatic standardization; an Atomat back-scatter thickness gauge. A number of densitometers are available, each based on a vacuum cell photometer having a very fine sensitivity coupled with a high degree of stability. Then there is the B.D.11 condenser ionization chamber. This is a very compact unit and constitutes a relatively accurate means of measuring stray X and gamma radiation. It is used in conjunction with the Baldwin protection electrometer, which is a very reliable, easy to use, charging and measuring device.

A selection of instruments for the indication, recording and controlling of temperature, pressure and other variables, is being shown on Stand No. 601 by the **Cambridge Instrument Company Ltd.** Among the items shown are a multi-purpose process controller that records and controls temperature and pressure variables to a pre-set programme of eight or more operations. There are also an entirely new indicator controller, a pocket *p*H meter, an electronic recorder controller, an electronic conductivity recorder, temperature measuring instruments, and a general purpose polarograph.

An eye-catching small-scale working automatic production plant, turning out "Tomics," is the way in which the **Electrical Development Association** is drawing attention to "Electronic Control —A Step Towards Automation" on their stand, No. 301. Industrial heating is also being featured on the stand, and several displays are being devoted to showing induction heating and infra-red heating.

A very comprehensive range of electrical testing equipment, servo-mechanism equipment and electronic process control equipment is shown on the stand (No. 404) of **Evershed and Vignoles Ltd.** The instrument section includes a range of "Megger" insulation and continuity testers, bridge testers, "Dionic" steam and water purity testing equipment, and a range of polarographs for chemical analysis. The instrumentation and control section shows process control equipment based on the Evershed electronic repeater system of measurement and control for nuclear, petroleum, chemical, boiler, and iron and steel plant.

Among the many new items to be shown by **The General Electric Co. Ltd.** on Stand No. 410, are a wide-band reflectometer display system; a D.C. transistor inverter; a transistorized liquid-gauging unit; a fabricated dip-brazed aluminium waveguide; a travelling wave tube, and "packaged" transistor oscillators. A wide range of electronic valves and cathode ray tubes, instruments for measuring electrical quantities, semi-conductor devices, and process heating and radio communication equipment, are also on view.

A representative range of their equipment—instruments for optical methods of analysis, surveying photogrammetry, and engineering metrology and inspection, is being exhibited by **Hilger and Watts Ltd.** A medium direct-reader gives automatic analysis of up to eleven elements in an alloy in about 2 min. It is generally used for non-ferrous metals, oils, soil and similar materials, but can also be used for certain types of ferrous work. Results can be given on a meter, a pen recorder, or on the Hilger printer. Other instruments displayed include a range of digitizing equipment, the microfocus X-ray generators, synthetic crystals, wave guide components, surveying instruments, microscopes, and smaller analytical instruments.

A wide range of instruments and automatic controls, electronic and otherwise, is being shown on Stand No. 407 by **Honeywell-Brown Ltd.** New products are to be seen functioning alongside established instruments in simple and complex control systems. The display includes complete control systems for furnace temperature; flow ratios for furnace combustion; flow, liquid level and pressure in fractionating column. Also displayed are non-indicating control systems for simple or low-temperature industrial processes, and for heating, ventilating and air-conditioning systems. Then there are flow, level and pressure instruments, temperature equipment for industrial processes, heating and ventilating controls, and a comprehensive display of snap-acting switches.

Occupying Stand No. 607, **Kelvin and Hughes (Industrial) Ltd.** have included several new instruments in their display. A multi-channel dynamic strain recording equipment facilitates the simultaneous recording of up to eight variables. A new pressure controller for oil-fired boilers is shown. This system incorporates a photo-transistor circuit which has been specially developed for the automatic regulation of oil burners on shell type boilers. Also shown for the first time is a new ultrasonic flaw detector—the Mark 6—which offers greater versatility and higher standards of performance. Gas analysis, smoke detection and the measurement of temperature, flow and draught, are also demonstrated.

A selection from their diverse range of products is being shown on Stand No. 414 by **The Morgan Crucible Company Ltd.**, with their associated companies, Morganite Resistors Ltd. and Morgan Refractories Ltd. Among the productions shown are carbon engineering components; sintered metal friction facings; resistors (voltage sensitive); heavy duty resistors; ultra high ohmic resistors; oil-retaining bearings; fixed and variable carbon resistors for the telecommunications industry, and tubes and insulated tubes.

Among a wide range of electronic equipment and instruments shown by **Mullard Limited** on Stand No. 501 are several new items. These include an entirely new system of sequence switching for the automatic control of transfer machines and other machines performing a number of sequential operations, batch counters, etc. Then there is a high resolution nuclear magnetic resonance equipment which is a completely self-contained system for high resolution proton spectrography by magnetic resonance. While the chief application of the present equipment will be in chemical research for analysis of the molecular structure of compounds and the identification of particular species, the method also has potential uses in process control operations. Also, there is a new dual-tank ultrasonic cleaning unit designed for batch processing of small components and piece parts, such as instrument mechanisms. It is intended particularly for situations requiring speedy and efficient cleaning on a production scale, but where throughputs are not large enough to justify automatic conveyorized plant.

Demonstrating various instruments and equipment representative of their range on Stand No. 409, **Philips Electrical Ltd.** have a new series of nuclear research equipment, including pre-amplifier, linear amplifier, electronic timer, single channel analyser, H.T. power unit, and 5 kV supply. Demonstrations are also being given of the stroboscopic X-ray examination of assemblies subject to vibration and housed in opaque materials, a new application of X-rays in non-destructive testing. Exhibited for the first time in this country is a reactor control panel of a type now in production for the Netherlands atomic authorities.

The Metals Division of **The Telegraph Construction and Maintenance Co. Ltd.** are showing, on Stand No. 942, their range of vacuum melted nickel iron magnetic alloys, controlled expansion alloys, thermostatic bimetals and beryllium copper. A number of new standard designs of magnetic shields for transformer and cathode ray tube applications have been introduced, while **Sankey-Telcon Ltd.** are displaying investment castings covering aircraft and gas turbine guide vanes, and other engine components in Nimonic, cobalt-based high-temperature alloys; also intricate waveguide components used in radar equipment, in aluminium and gunmetal.

Forthcoming Meetings

April 21—Institute of Metal Finishing. London Branch. Northampton Polytechnic, St. John Street, London, E.C.1. "Silver Plating with Particular Reference to Silver Anodes." R. R. Benham. 6 15 p.m.

April 25—Institute of Metal Finishing. Sheffield and North-East Branch. Grand Hotel, Fitzwilliam Room, Sheffield. "Design and Use of Jigs in the Plating Industry." J. J. Preston. 7 p.m.

Metal Market News

NO great change was seen in the prices of non-ferrous metals last week, at any rate on balance, but fluctuations occurred during the four days of trading, for tin, at any rate, closed quite a bit below the best for the forward position. Both copper and zinc were active, and the turnovers were rather above average, especially if one considers that the Exchange was closed on the Bank Holiday. Following a fairly good opening after Easter, the Stock Exchange fell away towards the end of the week under the adverse influence of the dangerous outlook on the industrial front, where the prospect of widespread trouble in the world of transport looms very near. In the United States the situation remains unchanged, and Wall Street sessions displayed both moderate strength and weakness. According to reports filtering through, it appears that there is a certain amount of short time being worked in the non-ferrous industry at present, and there are indications that consumption shows signs of falling away in copper and zinc. The publication of the American zinc statistics for March drew attention to the poor state of affairs in that metal in the United States, but the London market appeared to pay little attention to the further deterioration in the position. L.M.E. warehouse stocks did not show much change, but the copper tonnage advanced by 250 tons to 19,657 tons, while the tin tonnage dropped by 178 tons to 18,287 tons. Naturally, the Easter break reduced the volume of business quite considerably, and all last week the demand by the consumers was well below average.

As already mentioned, the turnover in standard copper was rather above average, and for the four days of trading no less than 10,000 tons changed hands, without Kerb dealings which probably accounted for several hundred tons more. On balance, cash lost £2 10s. 0d., while three months closed 25s. lower, the contango, which a week earlier had been only 5s., expanding to £1 10s. 0d. It looks as though demand were mainly for the three months' position, and that holders of cash are fairly keen to lend copper to the market. In New York, the custom smelters reduced their price by 50 points to 23½ cents in mid-week, while the Belgian quotation dropped from 25 francs per kilo to 24¼. On the other hand, the news that the producers had served *force majeure* notices on their customers in respect of copper ex Chuquicamata was responsible for some firming up in the quotation in London. The New York commodity market fluctuated, not altogether in line with movements in London, and the impression is gaining ground that the back of the big bull movement by speculators is broken. Activity is still brisk, but has somewhat diminished from what it was at its best. It is reported that Chilean representatives are on their way to London for discussions on copper and that, in fact, there will be a meeting between the producers and consumers early in May. This is the second meeting of its kind, the first being held some six months ago. It is understood that the proceedings are entirely private but that the price question will not be discussed. The New York Commodity Exchange finished the week on a slightly firmer note.

In tin there was a turnover of some 620 tons, cash being down £1 and three months 10s. dearer. A firmer tone in the East in the early part of the week served to lift the quotation in London, but the recovery petered out rather quickly. The outlook appears to be reasonably good, but there are bad patches here and there. It is reported, for example, that the Arnhem smelter has been obliged to put off a number of workers, presumably owing to shortage of raw material. Lead and zinc were both rather featureless, but the latter was active with a turnover of 6,550 tons. On balance, April was quoted 15s. lower while July was unchanged. In lead, about 2,100 tons changed hands, values being unchanged apart from a rise of 2s. 6d. in July.

New York

Copper was quiet throughout last week. Custom smelters sold limited quantities at 23·50 cents. Producers reported routine business at 25 cents per lb. Scrap was steady and quiet, and the buying price was again quoted at 18 cents by all leading smelters. One smelter reduced his buying price to 17·75, but the better tone in London was an influencing factor in its returning to the 18 cent level.

Copper futures were fairly active, with gains ranging to about 40 points. The firmness reflected the better tone in London. There was said to be a fair amount of speculator buying and short covering.

One of the two major consumers of copper products, the brass mill industry, is limping along with no improvement in sight from the low rate of demand for its goods, it is reported. Wire mills, the other major user of copper, which have been operating at somewhat better rates than the brass mills, report, however, that business "still leaves much to be desired."

February shipments were reported to be the poorest in a long time, and March shipments were not much, if any, better. The outlook for April did not indicate any change, nor did it appear that any improvement would take place, at least for the first nine months, unless something unusual occurred.

Lead and zinc were quiet and unchanged. The shipment of replacement batteries in February was the smallest for any month since May of last year. The February total was 1,804,000 units, as compared with 2,004,000 in January and 1,960,000 in February 1957, according to figures issued by Dun and Bradstreet.

The cut in the lead price early in the previous week raised the question in industry circles whether the price of zinc would be trimmed. Zinc is considered vulnerable for many of the same reasons that prompted the reduction on lead, i.e. a halt in Government stockpile buying, little exchange of surplus U.S. farm products for foreign metal in the wake of Government restrictions on these barter transactions, a continued slump in consumer demand, and foreign metal available at prices below the U.S. quotations.

Tin firmed, reflecting the better tone in London and Singapore, but buyers remained out of the market. Later, some business was reported at slightly easier prices.

Major suppliers of platinum continued to maintain their rates to the public of 72 dollars per troy ounce for bulk quantities and 75 dollars for smaller amounts. However, metal in fair quantities was available from outside market dealers as cheap as 68 dollars an ounce. Consumption and demand still failed to rally from the low level which has prevailed since the beginning of the year.

Paris

Copper demand is very feeble and the market extremely calm. It is believed that a possible price reduction might be encouraging consumers to hold off buying or, at best, to buy only from day to day.

On the other hand, aluminium consumption in France continues to rise. Between 1953 and 1957, inside the French zone, consumption doubled, while between 1956 and 1957 there was an increase of 15 per cent.

It is noted that many more industries are now turning to aluminium or greatly increasing their use of the metal.

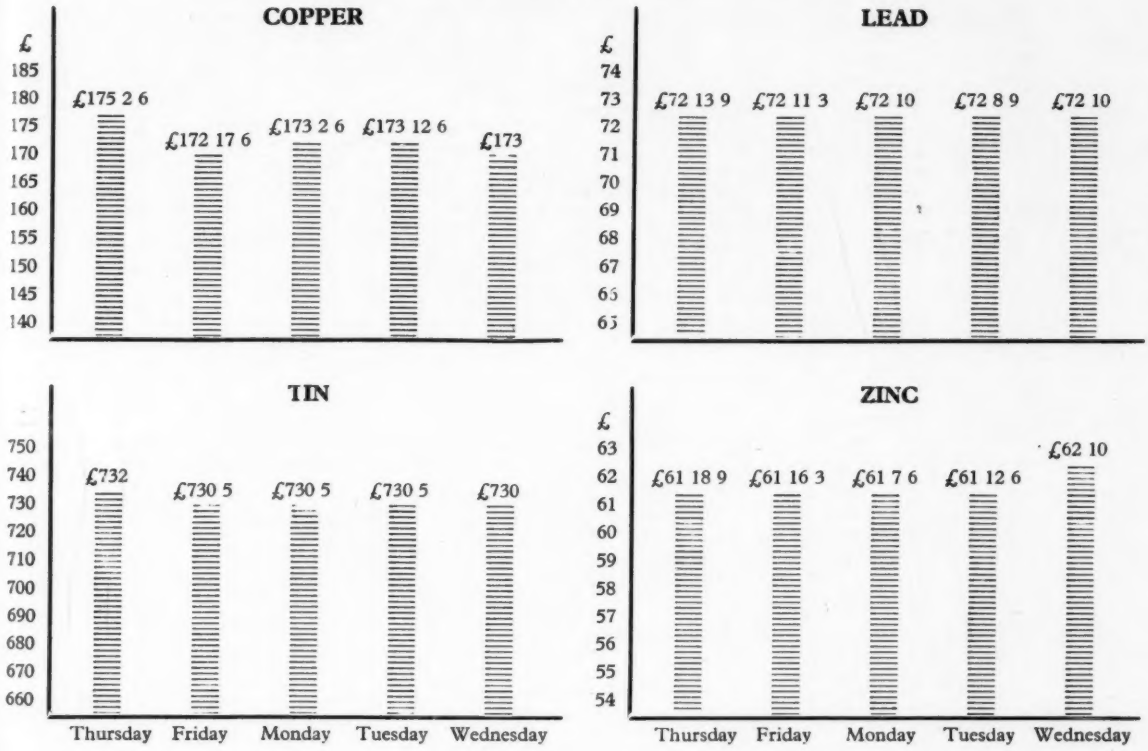
Zurich

Demand for gold and silver on the Swiss precious metal market during the week to April 9 was at the previous week's level, but sales of all other metals, particularly of platinum and palladium, tended to decline somewhat. This fall was mainly attributed to seasonally reduced buying by watch manufacturers and jewellers.

Platinum and silver prices declined during the period under review while palladium firmed somewhat.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 10 April 1958 to Wednesday 16 April 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10	2.50	209 0	26.10	208 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0	2,550	1,479 0			155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							375	217 10				
Electrolytic	24.25	177 5	24.25	200 7 6	227	197 10			2.10	175 12 6	25.00	200 0
Lead			11.25	93 0	114	99 2 6	177	102 12 6	.95	79 10	12.00	96 0
Magnesium												
Nickel			71.50	590 10	1,060	922 5	1,330	771 10	7.80	652 5	74.00	592 0
Tin	100.50	734 12 6			874	760 7 6	1,410	817 17 6	8.70	727 10	92.25	738 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	156	90 10	.82	68 10	11.75	94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 16/4/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	173	0	0
Fire Refined 99·70%	„	172	0	0
Fire Refined 99·50%	„	171	0	0
Copper Sulphate	„	66	0	0
Germanium	grm.		—	
Gold	oz.	12	9	0
Indium	„		10	0
Iridium	„	26	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	10	0
Magnesium Ingots	lb		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	77	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum	„	26	15	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4⅛
Tellurium	lb.		15	0
Tin	ton	730	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„		12	6
Dust 95/97%	„	104	0	0
Dust 98 99%	„	110	0	0
Granulated 99+%	„	87	12	6
Granulated 99·99+%	„	100	12	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	155	0	0
B.S. 1490 L.M.2	„	161	10	0
B.S. 1490 L.M.4	„	182	10	0
B.S. 1490 L.M.6	„	204	10	0
†Average selling prices for February				
***Aluminium Bronze**				
BSS 1400 AB.1	ton	200	0	0
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35	„	130	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% tin	ton		—	
(85/5/5/5)	„	154	0	0
(86/7/5/2)	„	165	0	0
(88/10/2/1)	„	212	0	0
(88/10/2/½)	„	221	0	0
Manganese Bronze				
BSS 1400 HTB1	„	164	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	240	0	0
Phosphor Copper				
10%	„	210	0	0
15%	„	218	0	0
**Average prices for the last week-end.*				
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	345	3	0
Grade D Plumbers	„	279	6	0
Grade M	„	378	0	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9	„		—	
Zinc Alloys				
Mazak III	ton	93	17	6
Mazak V	„	97	17	6
Kayem	„	103	17	6
Kayem II	„	109	17	6
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0

		£	s.	d
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M. Plate as rolled			2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP. Plate heat treated	„		3	5½
BS1475. HG10W. Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP. Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	4½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	205	0	0
Extruded Bar	lb.		1	7½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	143	0	0
Condenser Plate (Naval Brass)	„	154	0	0
Wire	lb.		2	2½
Copper Tubes	lb.		1	8½
Sheet	ton	199	10	0
Strip	„	199	10	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	222	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	1½
Lead Pipes (London)	ton	115	5	0
Sheets (London)	„	113	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3
Wire 10%	„		3	9½
Phosphor Bronze				
Wire	„		3	5½
Titanium (10,000 lb. lots)				
Billet 11"-4"	lb.	69/-		60/-
Wire ·315"-·036"	„	101/-		201/-
Sheet (4'/8'×2') ·160"-·010"	„	100/-		158/-
Strip ·048"-·003"	„	100/-		350/-
Tube Representative gauge	„	320/-		
Extrusions	„	137/-		
Zinc Sheets, English destinations	ton	95	15	0
Strip	„	nom.		

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 15/4/58.

	£
Aluminium	
New Cuttings	145
Old Rolled	120
Segregated Turnings	85
Brass	
Cuttings	112
Rod Ends	109
Heavy Yellow	95
Light	90
Rolled	104
Collected Scrap	94
Turnings	104
Copper	
Wire	150
Firebox, cut up	150
Heavy	145
Light	140
Cuttings	150
Turnings	137
Braziery	117
Gunmetal	
Gear Wheels	147
Admiralty	147
Commercial	124
Turnings	119
Lead	
Scrap	62/3
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	124
Turnings	119
Zinc	
Remelted	53
Cuttings	42
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£156.12.6)	180
Heavy copper	(£152.5.0)	175
Light copper	(£130.10.0)	150
Heavy brass	(£100.0.0)	115
Light brass	(£69.12.6)	80
Soft lead scrap	(£57.10.0)	66
Zinc scrap	(£39.2.6)	45
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£200.2.6)	230
Heavy copper	(£200.2.6)	230
Light brass	(£148.0.0)	170
Zinc castings	(£67.0.0)	77
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£130.10.0)	150
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£188.10.0)	325
Aluminium copper alloy	(£101.10.0)	175
Lead, soft, first quality	(£83.10.0)	144
Lead, battery plates	(£48.15.0)	84
Copper, first grade	(£174.0.0)	300
Copper, second grade	(£162.10.0)	280
Bronze, first quality machinery	(£177.0.0)	305
Bronze, commercial gunmetal	(£148.0.0)	255
Brass, heavy	(£124.15.0)	215
Brass, light	(£113.2.6)	195
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

LIGHT METALS STATISTICS IN JAPAN
(December, 1957)

Classification	Production	Shipment	Stock	Export
Alumina	11,867	12,039	15,107	0
Aluminium				
Primary	5,454	5,707	3,701	54
Secondary	1,618	1,611	293	0
Rolled Products	5,208	5,160	1,480	556
Electric Wire	1,309	914	1,067	180
Sheet Products	1,506	1,627	—	46
Castings	1,620	—	—	—
Die-Castings	848	—	—	—
Forgings	70	—	—	—
Powder	—	—	—	—
Primary Aluminium (January)	5,432	5,863	3,270	554
Sponge Titanium	141	—	—	114
Magnesium	66	71	4	0
Secondary	173	141	128	0

British Aluminium Co. Ltd.

The group net assets of the British Aluminium Company expanded from £32,927,981 to £37,110,148 in 1957, with net current assets up from £10,738,191 to £12,778,140.

Investment in the subsidiary, the Canadian British Aluminium Company, was increased from £6,564,599 to £7,907,555.

It is proposed to increase the authorized capital from £12m. to £15m. by the creation of new Ordinary shares. It is also proposed that the existing 500,000 unissued Preference shares will become unissued Ordinary shares. No further capital will be issued at present.

Group net profit for 1957 is £1,247,389 (£1,330,989), and the Ordinary dividend is 12 per cent (same), of which the final of 8 per cent is on the enlarged capital.

General Refractories Ltd.

Trading profit of the group for 1957 was £1,156,792, an increase of £256,048 over 1956. Net profit was £394,060, of which £11,220 was attributable to outside shareholders and £14,979 was retained by subsidiary companies. Group net profit amounts to £367,861, to which was added the amount brought forward of £155,058, making a total of £522,919. The sum of £191,372 is to be transferred to general reserve, leaving a balance of £331,547. Dividend 20 per cent, less income tax, absorbs £143,750, leaving a balance of £187,797 to be carried forward as compared with £155,058 brought in.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Corrosion Technical Services Limited (599205), 30 Craven Street, W.C.2. Registered February 20, 1958. To carry on business of dealers in and manufacturers' agents, importers and exporters and manufacturers of all types of anti-corrosive coatings, etc. Nominal capital, £1,000 in £1 shares. Directors: Leslie M. Froude and H. N. Inch.

Chalfont Clasps Limited (599240), 18 Nixon Street, Newcastle upon Tyne, 2. Registered February 21, 1958. To carry on business of manufacturers of and dealers in aluminium and aluminium and other sheeting, holloware, tinplate and sheet metal work of all kinds, etc. Nominal capital, £1,000 in £1 shares. Director: Henry H. King.

Industrial Magnets Limited (599282), 28 Station Road, Acocks Green, Birmingham, 27. Registered February 21, 1958. To carry on business of designers and manufacturers of and dealers in electro and permanent magnetic equipment, etc. Nominal capital, £1,000 in £1 shares. Directors: John F. Cordwell and Clifford F. Walker.

Minerals and Trading (London) Ltd. (599378), Winchester House, Old Broad Street, E.C.2. Registered February 24, 1958. To carry on business of traders and dealers in, importers and exporters, producers and manufacturers of minerals, metals, chemicals, etc. Nominal capital, £100 in £1 shares. Directors: Lilian I. M. Thomas and Keith Nordon.

T. Miller Limited (599436). Registered February 25, 1958. To take over business of dealers in non-ferrous metals carried on at 2 Bescott Drive, Walsall, by T.M. (Metals) Ltd. (formerly called T. Miller Ltd.), etc. Nominal capital, £100 in £1 shares. Directors: Thomas Miller, Stanley G. Morgan and Harold Burke.

J. Liversidge and Son Ltd. (599564), Old Leeds Steel Works Sidings, Pepper Road, Leeds, 10. Registered February 26, 1958. To take over the business of scrap metal merchants carried on at Leeds by W. G. Liversidge as "J. Liversidge and Son," etc. Nominal capital, £20,000 in £1 shares. Permanent directors: Wm. G. Liversidge and Wm. Liversidge.

Griffin and George (Technical Services) Limited (599582), 285 Ealing Road, Alperton, Wembley, Middx. Registered February 27, 1958. To provide scientific and technical advice and services, etc. Nominal capital, £100 in £1 shares. Directors: Kenneth G. Sinclair, Robert H. Powell and Harold C. Mayer.

Basford Foundry Limited (599749), Lincoln Street, Old Basford, Nottingham. Registered March 3, 1958. To carry on business of brass, bronze and iron founders, etc. Nominal capital, £1,000 in £1 shares. Directors: Harold Ellis and John H. Shearman.

A. D. Hall Limited (599850). Registered March 4, 1958. To take over business of manufacturers and merchants of metals carried on as "A. D. Hall" at Crackley Bank, Chesterton, Staffs., etc. Nominal capital, £3,000 in £1 shares.

THE STOCK EXCHANGE

Industrials Anticipated Budget With Confidence And Business Expanded

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 15 APRIL +RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	19/3 +9d.	10	10	10 7 9	19/9	17/9	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6	8½	7½	11 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	50/6 +2/3	15	15	5 18 9	51/–	47/–	72/3	47/9
1,590,000	1	Birfield Industries	51/– +1/6	15	20N	5 17 9	53/9	49/6	70/–	48/9
3,196,667	1	Birmid Industries	60/6 +2/9	17½	17½	5 15 9	60/6	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	25/7½ +1/4½	10	8	7 16 0	26/7½	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/7½	5	5	6 8 0	15/7½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/10½	6	6	7 2 3	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/10½	12½	12½	9 6 0	28/9	26/10½	30/3	28/9
300,000	1	Ditto Pref. 5%	15/6	5	5	6 9 0		—	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/3	7	7	7 5 6	19/3	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	44/3 —9d.	12	12	5 8 6	46/6	41/3	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/3 +3d.	6	6	6 4 9	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/3 +1/–	12½	12½	5 18 6	42/3	38/10½	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord ...	35/3 +1/–	10	10	5 13 6	35/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/10½ —1½d.	25	25	5 19 9	21/–	20/1½	24/6	19/3
60,484	1/–	Carr (Chas.)	2/1½	25	25	X8 4 9	2/3	2/–	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/6 +1½d.	25	25	11 2 3	4/9	4/4½	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	17/– +7½d.	10	10	11 15 3	17/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½	6	6	7 11 3		—	17/6	16/–
250,000	2/–	Coley Metals	3/6 +3d.	25	25	14 5 9	4/6	3/3	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	47/9 +1/3	22½	22½	9 8 6	51/6	43/–	92/6	49/–
1,136,233	1	Davy & United	46/6 +9d.	15	12½	6 9 0	48/–	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	19/– —6d.	30	•17½	7 18 9	21/4½	19/–	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	31/6 +1/–	15B	22½	7 18 9	31/6	24/–	38/6	25/–
500,000	1	Evered & Co.	39/–	15	15	7 13 9	41/3	39/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	32/9 +2/3	12½	14	Y7 0 6	38/7½	29/6	59/–	38/–
1,250,000	Stk. (10/–)	General Refractories Ltd.	33/9	20	17½	5 18 6	33/9	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/–	15	12	4 12 3	66/3	64/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	6/–	11½	11½	9 11 9	6/–	5/7½	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	13/6	20	20	7 8 3	13/6	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	21/6xcap +1/3	18Z	16	5 11 6	21/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	46/9	17½	17½	7 9 9	46/10½	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	12/– —4½d.	•15	•30‡	6 5 0	12/4½	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9	7	7	7 9 3		—	22/3	18/7½
1,075,167	5/–	Heenan Group	7/3 +1½d.	10	20‡	6 18 0	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	44/10½ +1/1½	12Z	10	5 7 0	44/10½	36/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/3 +3d.	5	5	6 3 0	17/1½	16/–	18/6	15/6
14,581,025	••	International Nickel	134 —2	$3.75	$3.75	5 0 0	144½	134	222	130
430,000	5/–	Jenks (E. P.), Ltd.	6/9xcap	27½ ϕ	27½	10 3 9	7/9¾	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	5	5	6 3 0	16/3	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	40/6 +1/–	10	9	4 18 9	41/3	37/6	58/9	40/–
600,000	10/–	Keith, Blackman	16/3	15	15	9 4 6	16/3	15/–	21/9	15/–
160,000	4/–	London Aluminium	3/1½	10	5	12 16 0	4/3	3/1½	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	43/9 +9d.	12½	12½	5 14 3	43/9	39/9	54/6	41/–
400,000	1	Ditto Pref.	22/9	7½	7½	6 11 9	22/9	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	32/6 —2/6	15	15	9 4 6	35/–	32/6	48/9	37/6
1,530,024	1	Ditto A Ord.	30/– —2/6	15	15	10 0 0	32/6	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	10/6 +3d.	27½‡	25	6 11 0	10/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–	7½	7½	7 10 0	6/–	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	48/6 +1/9	20‡	15M	4 2 6	48/6	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	6/6	50	50	15 7 9	6/6	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	21/9	10	10	9 4 0	22/9	21/9	25/–	21/6
80,000	5	Ditto Pref. 6%	83/6	6	6	7 3 9		—	90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	40/– +1/–	10	11	5 0 0	40/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/–	5½	5½	6 9 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	53/6	20	20	7 9 6	57/6	53/6	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge) ...	7/3	10	10	6 19 0	7/3	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	27/–	27½D	27½	6 15 9	27/–	26/–	41/–	24/9
1,365,000	Stk. (5/–)	Serck Radiators	12/4½ +10½d.	17½Z	15	4 14 3	12/4½	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings) ...	43/9	16	16	7 6 6		—	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/3 +3d.	6½	6½	6 8 6	20/3	20/–	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	54/6 +1/–	15	15	5 10 0	54/6	48/ ½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	31/9 +1/9	10	10	6 6 0	31/9	29/4½	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/6	5	5	6 9 0	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/–	•5	•5	6 19 9A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	75/9 +6d.	20	15	5 5 6	75/9	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	37/9 +1/3	10	18P	5 6 0	37/9	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/9 —1½d.	25	40	6 9 0	8/–	7/2½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	16/4½ +3d.	27½	27½	8 8 0	16/4½	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/3	20	17½E	15 7 9	3/9½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6	6	6	10 8 9		—	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½	40D	33½	9 5 6	3/1½	2/7½	5/–	2/9

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting ••Shares of no Par Value. ‡ and 100% Capitalized issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%.